

FURBISH LOUSEWORT
(Pedicularis furbishiae)
REVISED RECOVERY PLAN

Prepared by

Susanna L. von Oettingen
New England Field Office
U.S. Fish and Wildlife Service
Concord, New Hampshire

for

Region Five
U.S. Fish and Wildlife Service
Newton Corner, Massachusetts

Approved: _____


Regional Director, Region Five
U.S. Fish and Wildlife Service

Date: _____

7-2-91

EXECUTIVE SUMMARY

FURBISH LOUSEWORT REVISED RECOVERY PLAN

Current Species Status: The Furbish lousewort is currently listed as endangered. A 1989 status survey determined that the population consists of approximately 6,900 flowering stems throughout the species' range. To date, no essential habitat or populations have been permanently protected.

Habitat Requirements and Limiting Factors: The lousewort is found on the banks of the St. John River in Maine and New Brunswick (Canada), in areas where the combination of suitable soils, moisture, and exposure allow its growth. Some natural disturbance, such as ice scour, is needed to maintain the vegetative successional stage conducive to Pedicularis furbishiae growth. Potential threats to lousewort populations include excessive disturbance of the riverbank, alteration of the river's hydrology, and clearcutting of bank vegetation.

Recovery Objective: Reclassification to threatened status.

Recovery Criteria: Maintain a geometric mean of 7,000 flowering stems for a period of six years and provide permanent protection for 50% of the essential habitat. Essential habitat consists of existing lousewort-occupied areas and, given favorable conditions, potential habitat.

Actions Needed:

1. Protect lousewort populations and their essential habitat.
2. Monitor populations trends and habitat conditions.
3. Coordinate with regulatory agencies and maintain international cooperation.
4. Assess threats to the species' recovery.
5. Study recolonization processes.
6. Develop and implement management recommendations.
7. If warranted, establish and maintain new populations.

Estimated Costs of Recovery (\$000s):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Need 7
FY 1	18.0	5.0		1.0	1.5		2.0
FY 2	20.0			4.0	1.5	4.0	2.0
FY 3	15.0	5.0		3.0	1.5	4.0	2.0
FY 4	13.0			1.5		4.0	2.0
FY 5	13.0	5.0				4.0	2.0
FY 6	13.0					2.0	2.0

Total Estimated Recovery Cost: Projected costs for reclassification amount to \$149,000.

Date of Recovery: Reclassification should be initiated in 1998, if recovery criteria have been met.

* * * * *

Based on additional information obtained through past recovery activities, the revised Furbish lousewort (Pedicularis furbishiae) recovery plan updates the recovery objective and recovery tasks of the previous Furbish lousewort recovery plan (U.S. Fish and Wildlife Service 1983) and delineates actions required to recover and/or protect the species.

This revised plan does not necessarily represent the views or official position of any individuals or agencies, other than the U.S. Fish and Wildlife Service. The plan is subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1991. Revised Furbish Lousewort Recovery Plan. Newton Corner, Massachusetts. 62 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
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ACKNOWLEDGEMENTS

Portions of this report were written under contract by Dr. Susan C. Gawler, Maine Natural Heritage Program. Throughout the development of this recovery plan revision, additional information and much-valued comments were provided by Hank Tyler of the Maine Critical Areas Program, Linda Gregory, Bar Harbor, Maine, and Barbara Vickery of the Maine Chapter of The Nature Conservancy.

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PART I: INTRODUCTION

Pedicularis furbishiae S. Watson (Furbish lousewort, St. John River wood-betony) is a perennial herb of the snapdragon family (Scrophulariaceae), and is endemic to the St. John River in northern Maine and New Brunswick, Canada. It was listed as endangered under the Endangered Species Act, as amended, on April 26, 1978 (U.S. Fish and Wildlife Service 1978). Following completion of the initial Furbish Lousewort Recovery Plan (U.S. Fish and Wildlife Service 1983), recovery activities generated new life history and population information. This additional information and the removal of the primary threat to the species (the proposed Dickey-Lincoln dams) have led to this revision of the 1983 recovery plan.

DESCRIPTION AND TAXONOMY

The Furbish lousewort, first collected along the banks of the St. John River in Van Buren, Maine by Kate Furbish in 1880 (Furbish 1881), was named and described by Sereno Watson in 1882. The plant has two growth forms, depending upon the reproductive condition of the plant in any particular year. Vegetative (non-reproducing) individuals grow as a basal rosette of leaves. Reproductive plants begin the year as a rosette of leaves, then produce leafy, flowering stems 0.4 to 1.0 m tall (Figure 1). The dark stems are usually covered with short hairs, sometimes conspicuously silvery white. A single reproductive plant produces 1-8 stems and occasionally as many as 15. The feathery leaves, alternately arranged on the stem, are stalked, lanceolate, and deeply pinnatifid. Frequently silvery-edged and often lightly pubescent, leaves are generally 5-15 (rarely 20) cm in length, except on first-

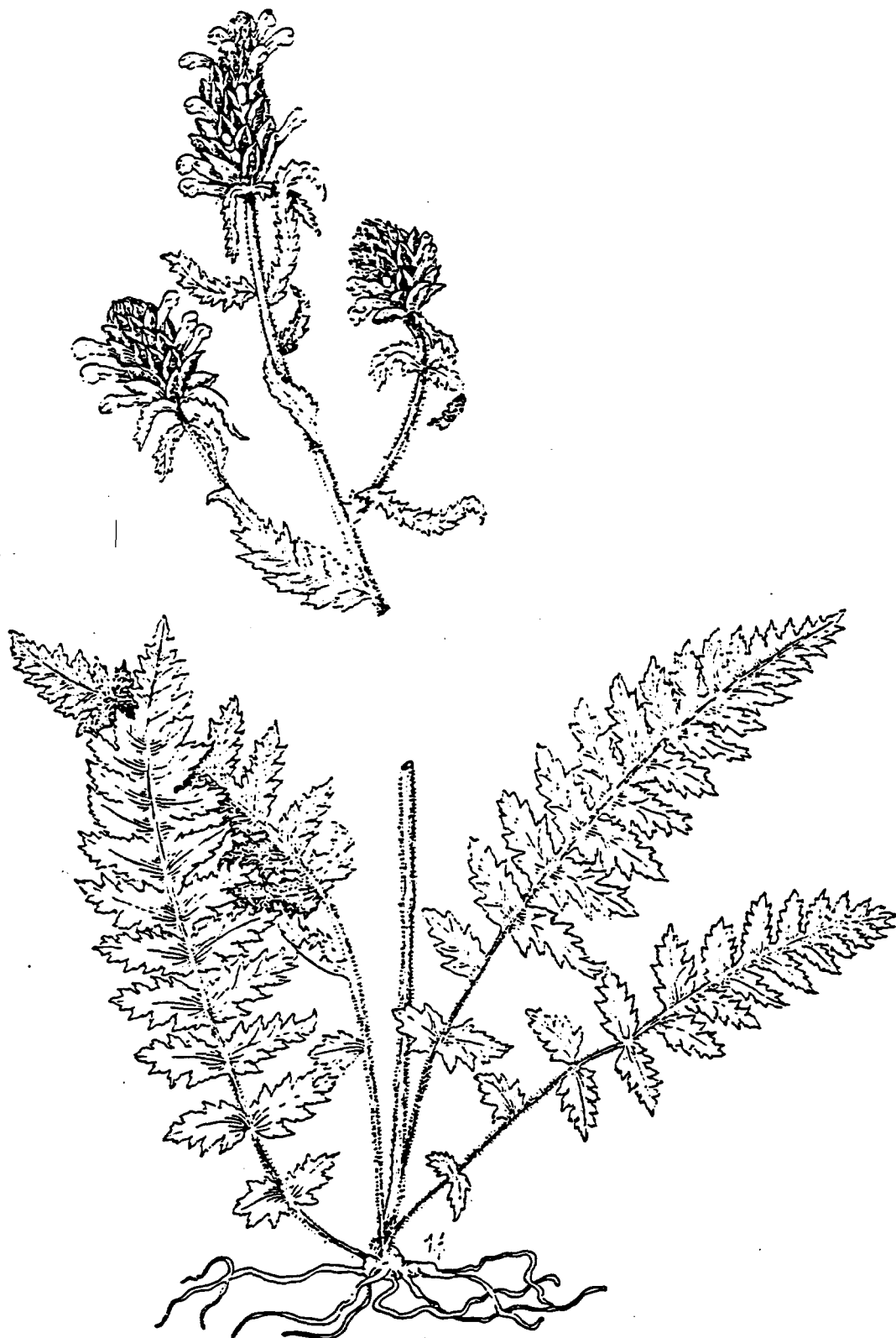


Figure 1. Pedicularis furbishiae S. Watson
Illustration by Tess Feltes. Taken from G.E. Crow.
1982. New England's Rare, Threatened, and Endangered
Plants.

year plants. A single stem may have more than one inflorescence, with each borne on a separate branch for a candelabra effect. The average inflorescence exhibits 25 flowers (Menges et al. 1986) in a dense raceme.

Each yellow flower has five sepals that are joined for part of their length, surrounding a tubular, two-lipped corolla. The yellowish upper lip of the corolla is straight and lacks the conspicuous beak typical of some of the other louseworts. The brownish lower lip is erect and three-lobed at the tip. The bracts below each flower are egg-shaped and toothed. Flowers mature from the bottom to the top of the raceme, with 5 to 7 flowers open at any one time. The fruits are small, egg-shaped capsules, 1-1.5 cm long, opening in autumn along a dorsal suture. The seeds are approximately 1 mm long, with a loose outer covering that may aid in dispersal.

While the taxonomic identity of Pedicularis furbishiae as a distinct species is unquestioned, its taxonomic position within the genus Pedicularis is unclear. None of the 34 North American Pedicularis species (Kartesz and Kartesz 1980) bears a close resemblance to Pedicularis furbishiae (Gawler 1988). Further, Pedicularis furbishiae is markedly different from the two other Pedicularis species found in the northeastern United States and Canada in habitat requirements, blooming phenology, structure, and pollination mechanisms (Gawler 1988).

It is possible that an Asian species is the direct ancestor of Pedicularis furbishiae, since the center of Pedicularis distribution is in the northern Himalayas and adjacent China and Siberia. Pedicularis furbishiae apparently arrived in the St. John Valley sometime after the most recent deglaciation, i.e., within the last 10,000 to 12,000 years, perhaps by long-distance dispersal from either western North America or Asia. Electrophoretic analyses detected no genetic variability among 28 plants from four populations, suggesting that Pedicularis

furbishiae may have arrived in the St. John valley as one or a few seeds (Waller et al. 1988).

DISTRIBUTION AND ABUNDANCE

The entire range of Pedicularis furbishiae covers 225 km of the St. John River, extending from a point 1.5 miles upriver of the confluence with the Big Black River in Aroostook County, Maine to the town of Andover, New Brunswick in Canada (Figure 2). This part of the St. John River is the longest stretch of free-flowing water remaining in the northeastern United States. Pedicularis furbishiae occurs only on the main stem of the St. John, not on its tributaries.

The Furbish lousewort has the most restricted geographical distribution of over 500 species in the genus Pedicularis. Between 1880 and 1917, the plant was collected from Van Buren upriver to T. 15 R. 13, as well as downriver of Van Buren in the Canadian towns of Grand Falls and Andover, New Brunswick. All subsequent locations of the species have been within the range extending from the confluence of the Big Black River in T. 15 R. 13 to the confluence of the Aroostook River in Andover, with two exceptions: (1) one plant found approximately 1.5 miles upriver of the Big Black River and (2) a population of several dozen plants along a railroad embankment less than 1/4 mile from the St. John River near Aroostook Junction, New Brunswick.

While the range limits of the species apparently have not changed within the last century, the distribution within that range has. Most early collections were from the downriver portion of the range (Fort Kent to Van Buren), likely due to the easy accessibility. At present, few individual plants survive downriver of the international bridge at Fort Kent.

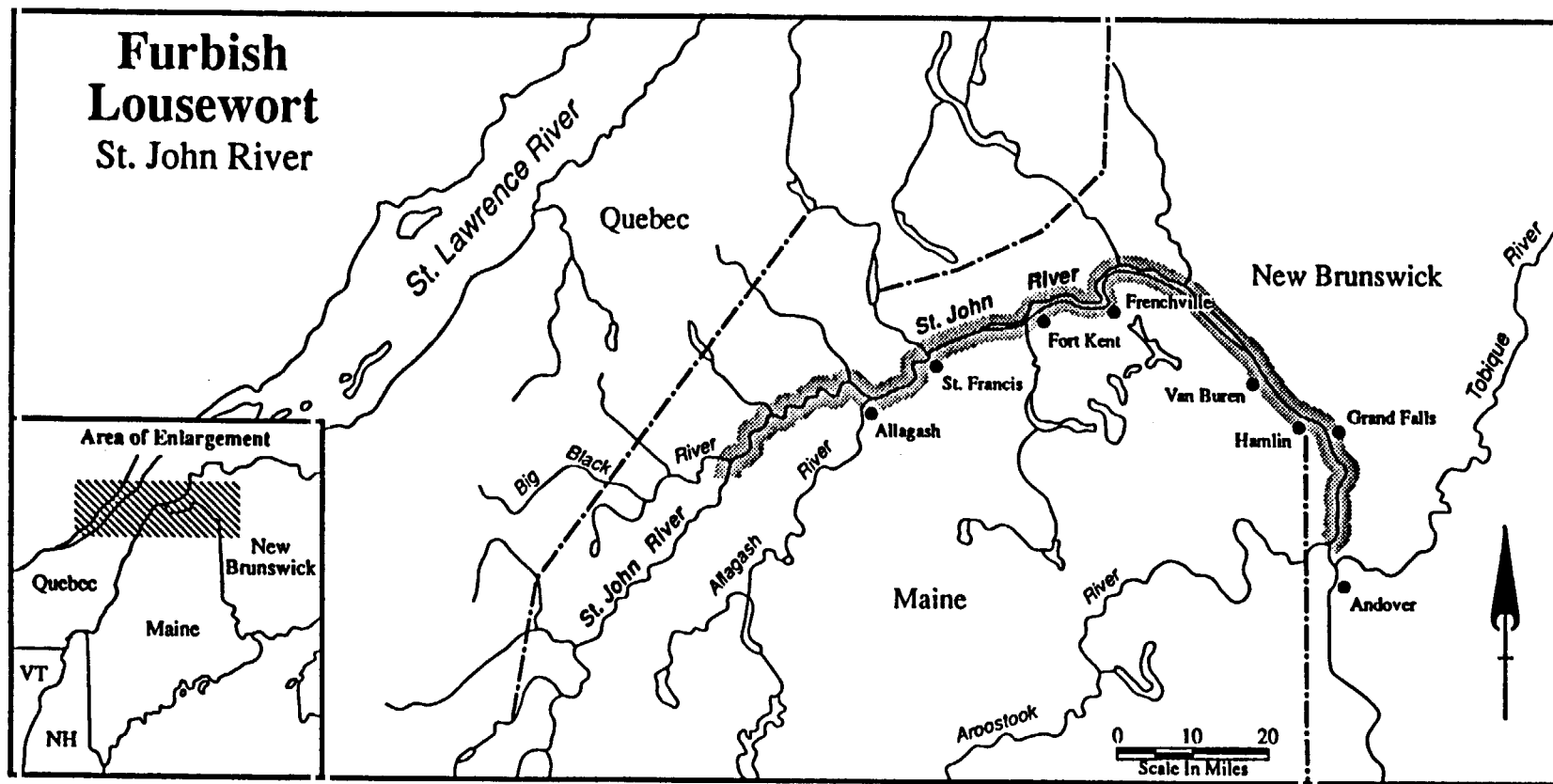


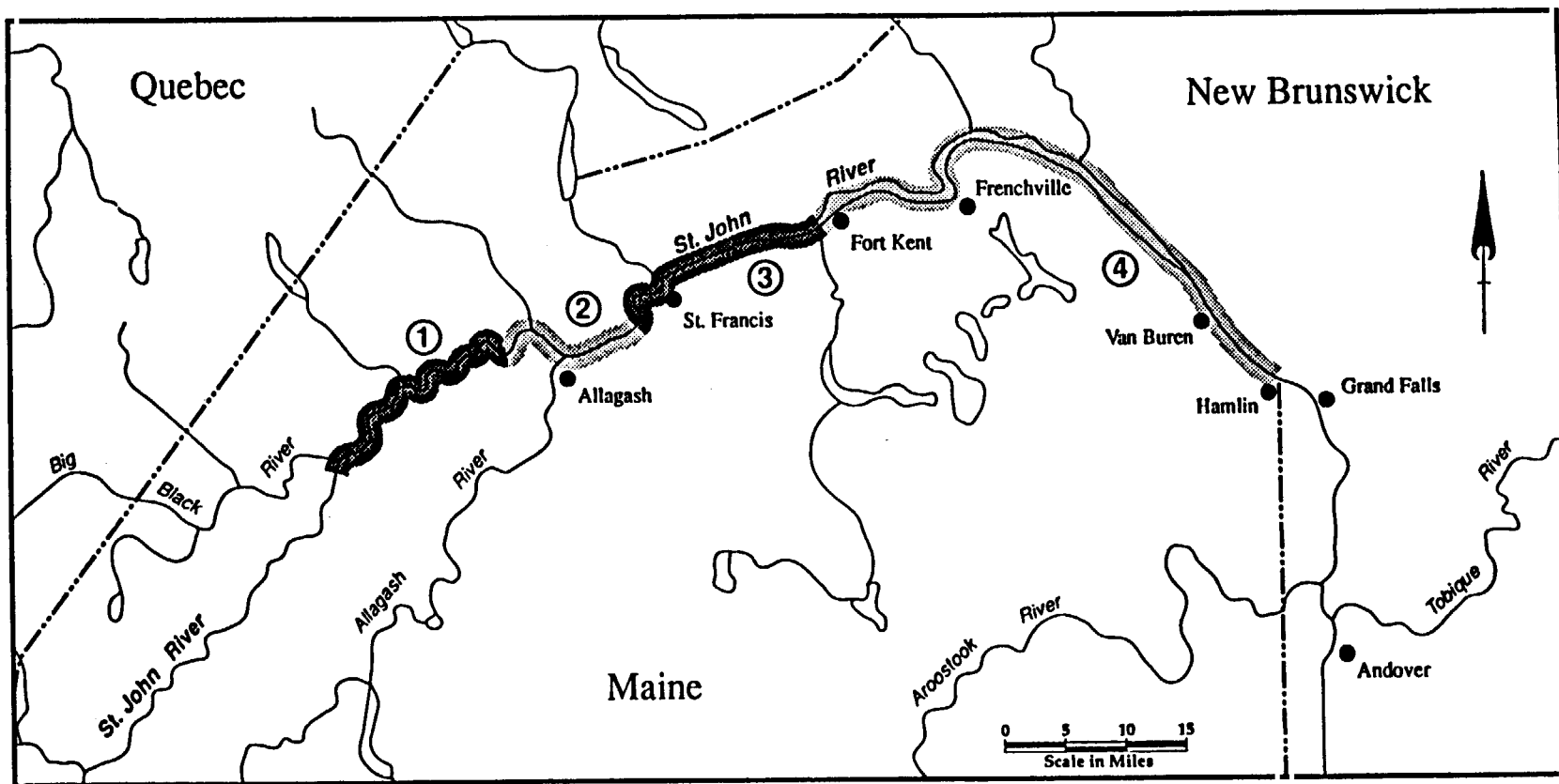
Figure 2. Furbish lousewort range

The type location in Van Buren and a station in Frenchville documented in 1937 both appear to have been extirpated. The only known individuals surviving between the bridge at Fort Kent and the Maine/Canada border are at one small population in Hamlin, Maine. Reasons for this decline are unknown.

The present U.S. distribution can best be pictured by breaking the range into four major sections, keyed to Figure 3. Section 1, approximately 26 miles long, has small scattered populations beginning 1.5 miles upriver of the Big Black River junction with the St. John River and running downriver to St. Clair Island. From St. Clair Island to 0.4 miles downriver of Wiggins Brook (Section 2), populations may be more or less continuous for several miles of riverbank; delineating a "population" in this section is often impossible. Lousewort numbers and densities are usually high within the river reach beginning 0.4 miles downriver of Wiggins Brook and ending at the Fort Kent bridge (Section 3). Here, populations are widely separated and may include hundreds of individuals. Section 4 is downriver of the bridge at Fort Kent to Hamlin. Although several historic occurrences have been recorded, during a 1989 status survey only one extant population was found in this section, with fewer than 50 plants.

Lousewort populations are notoriously difficult to delineate, because the linearity and dynamism of the habitat dictate that populations are rarely discrete units. Richards' (1980) stem count used "stations", i.e., areas of riverbank up to two miles long, rarely with continuous louseworts. The original recovery plan (U.S. Fish and Wildlife Service 1983) used the term "colonies" to describe population units. Based upon the current understanding of the population dynamics of the species, this revision has adopted "river segments" as the most descriptive unit. A river segment is defined as a stretch of riverbank bounded at its upriver and downriver ends by recognizable geographical features, e.g., the stretch

Figure 3. Sectional divisions of Pedicularis furbishiae range (U.S.).



May 1991

between two brooks. A particular river segment might have one to dozens of biological populations¹.

The U.S. range of the lousewort has been divided into 48 river segments (Gregory and Gawler 1990), of which 28 are currently known to support Pedicularis furbishiae (Table 1). Four others supported small populations (< 50 flowering stems) in the past, but were not checked during the 1989 survey due to time constraints or inaccessibility, and at least six other segments were not checked in great detail. Segments range from 0.2 to 3.6 miles in length.

Table 1. St. John River segments lengths (in miles), by section (Gregory and Gawler 1990).

River Seg	Stretch of Riverbank	Total Length
	Section 1	25.7
1	1.5 mi. upriver of Big Black R. jct. to the junction	1.5
2	Big Black jct. downriver 1.0 mi.	1.0
3	1 mi. DR of Big Black jct. to Ferry Landing	2.8
4	Ferry Landing to opp. Seminary Brook	1.1
4N	Upriver Seminary Brook on W Bank	0.3
5	Opp. Seminary Brook to Long's Rapids	3.0
6	Long's Rapids to opp. Chimenticook Stream	2.5
7	"Castonia" : opp. Chimenticook Str. to opp. Pocwoc Stream	3.3

¹ Defined as a group of individuals of the same species, functionally separated from other such groups.

Table 1. Continued.

River Seg	Stretch of Riverbank	Total Length
7N	Schoolhouse Rapids: W. Bank Castonia to Pocwoc Str.	1.4
8	Pocwoc Str. (opp.) to Ouellette Brook (opp.)	0.7
9	Ouellette Br. (opp.) to Fox Brook (opp.)	2.3
10	Fox Brook (opp.) to Halfway Brook (opp.)	1.6
10N	Fox Brook Ledges (N bank)	0.1
11	Halfway Br. (opp.) to Hafford Brook (opp.)	1.6
11N	Hafford Brook (N bank)	0.1
12	Hafford Br. (opp.) to Poplar Is. Campground (opp.), 1.1 mi DR	1.1
13	Opp. Poplar Isl. Cmpgrd, (1.1 mi. DR of Hafford Br.) to Carter Brook	1.3
14	Carter Brook to Campbell Brook	0.9
15	Campbell Brook to opp. Walker Brook	2.6
16	Opp. Walker Br. to upriver end of St. Clair Is.	0.7
	Section 2	14.6
17	Opp. St. Clair Is.	0.7
18	Downriver end St. Clair Is. to Dickey Bridge	0.9
19	Dickey Bridge to St. Paul's	1.3
20	St. Paul's to upriver end of Forest Service	1.2

Table 1. Continued.

River Seg	Stretch of Riverbank	Total Length
21	Allagash Delta: Upriver of Forest Service to Allagash	0.4
22	Allagash to Negro Brook	1.1
23	Negro Brook to a point 0.1 mi DR	0.2
24	A point 0.1 mi DR of Negro Br. to Casey Brook	0.7
25	Casey Brook to Wesley Brook	1.5
26	Wesley Brook to Wyles Brook	0.5
27	Wyles Brook to a point 0.5 mi DR of Wyles Br.	0.5
28	A point 0.5 mi DR of Wyles Br. to Cross Rock Landing	0.8
29	Cross Rock Landing to Wiggins Brook	0.3
30	Wiggins Brook to a point 0.4 mi DR	0.4
	Section 3	20.8
31	A point 0.4 mi DR of Wiggins Br. to McLean Brook	0.8
32	McLean Brook to Rankin Rapids	2.5
33	Rankin Rapids to Lincoln School	0.2
34	Lincoln School to Thibideau Brook	3.6
35	Thibideau Brook to a point 0.5 mi DR	0.5
36	A point 0.5 mi DR of Thibideau Br. to 0.7 mi UR of St. Francis town line	1.2
37	0.7 mi UR of the St. Francis town line to the town line	0.7
38	St. Francis town line to St. John	7.2

Table 1. Continued.

River Seg	Stretch of Riverbank	Total Length
39	St. John/Ft. Kent line to a point 2.1 mi DR	2.1
40	A point 2.1 mi DR of St. John/Ft. Kent line to a point 2.9 mi DR	0.8
41	A point 2.9 mi DR of St. John/Ft. Kent line to Ft. Kent Bridge	1.2
	Section 4	+0.6
42	Fort Kent Bridge to Van Buren Bridge	
43	Van Buren Station	0.3
44	Hamlin Station	0.3
	Total	+61.7

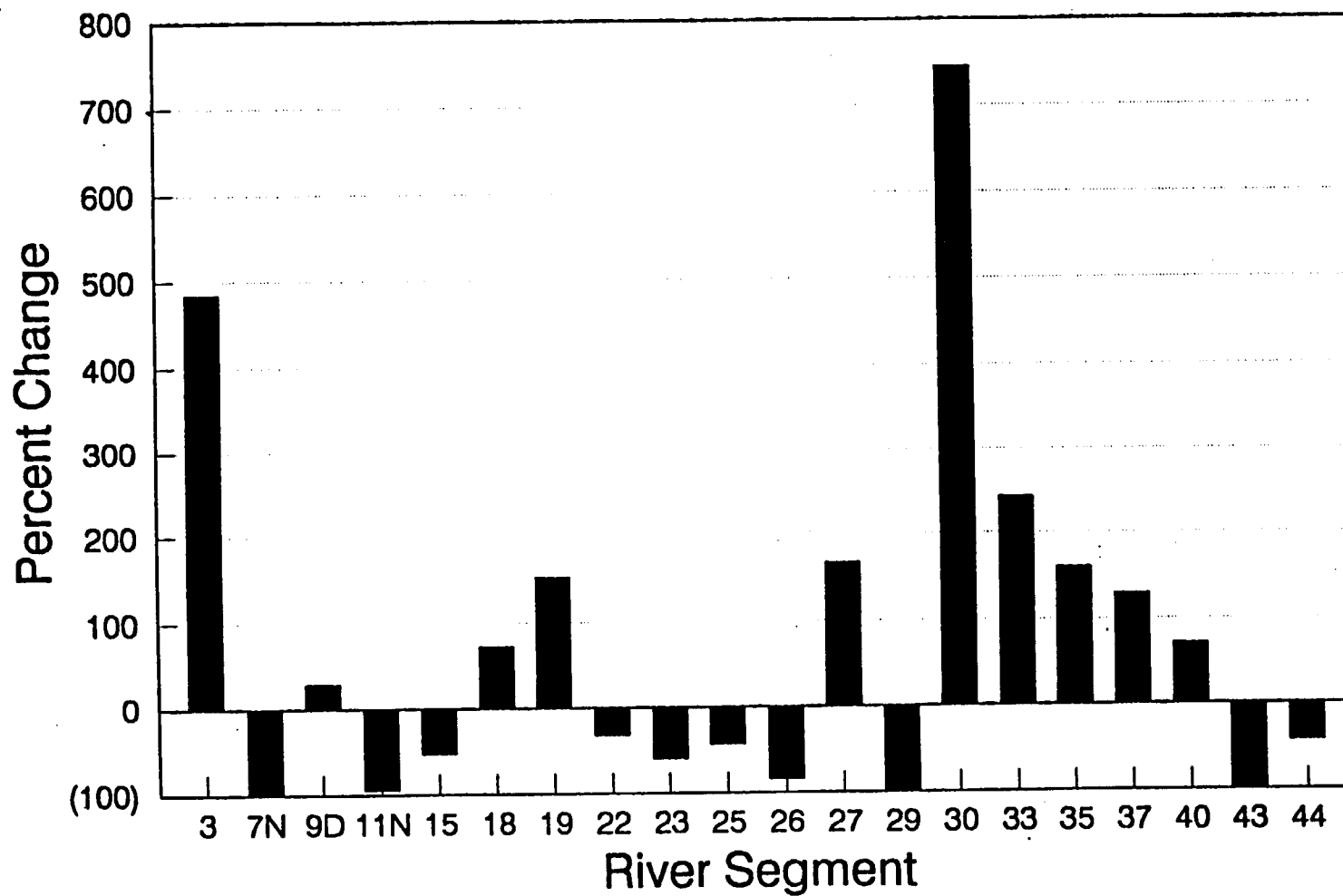
DR = Down river

UR = Up river

opp. = landmark on opposite (north/west) bank

The number of individuals within these population units in any given year cannot be taken as a long-term indicator of overall population size. Extensive censuses in 1980, 1984, and 1989 reveal dramatic fluctuations over time in the distribution of individuals in the same segment (Figure 4). In looking at the percent change of numbers of flowering stems over three different time periods (1980-1984, 1984-1989, and 1980-1989; refer to Table 3 on page 24), Gregory and Gawler (1990) determined that there was an overall increase of 29% in flowering stems within 23 river segments.

Figure 4. Percent population changes (1980-1990)



*Gregory and Gawler 1990

This increase included a 14% decrease during the 1980-1984 period and a 37% increase from 1984 to 1989. It should be noted that the general distribution of habitat remained more or less constant during this decade.

The number of flowering stems can be extrapolated to provide an estimate of the total population size. In the 1989 census, 6,889 flowering stems were counted. Based on the averages derived from 1983-1987 demographic research of 1.6 flowering stems per reproductive plant and 3.2 vegetative plants for every reproductive plant (Gawler 1988), it is estimated that there are currently 4,300 reproductive individuals (flowering stems) and 13,800 vegetative individuals in the total population, excluding seedlings. On average, 38% of vegetative individuals die before reaching reproductive maturity (Gawler 1988).

HABITAT

St. John River basin

The biology and conservation needs of Pedicularis furbishiae are inextricably linked to the dynamics of the St. John River. Flowing north and east 320 km from the headwaters to its first dam at Grand Falls, New Brunswick, the St. John carves through the boreal forests of northern Maine before widening into the rich farmland of the middle and lower valley. The entire St. John River basin is one of the largest on the Atlantic seaboard, draining approximately 55,300 km² (NERBC 1981). The upper St. John River (the part above and including the confluence of the Fish River at Fort Kent) drains 14,700 km². The major tributaries of the upper St. John are the Big Black, Allagash, St. Francis, and Fish Rivers (refer to Figure 2).

The portion of the St. John River basin incorporating the range of the Furbish lousewort has a number of distinctive characteristics. Most of the upper St. John river valley has a humid, continental climate with short summers and long, cold, snowy winters. The upper basin is underlain by Seboomook slate and graywacke of Devonian age, with local granitic intrusions (Kite 1983). Low hills bordering the pre-glacial valley dominate the landscape. The St. John River carves through thick glacial drift and post-glacial alluvium, while bedrock outcrops along the river are fairly rare. The complex pattern of deglaciation in the St. John Valley left varied glacial and post-glacial deposits (Kite 1983). These deposits include lacustrine silt-clay deposits and high fluvial terraces around the present villages of Dickey and Allagash, lacustrine silts in the St. Francis-Fort Kent area, and extensive beds of unconsolidated till in parts of Allagash and in the upriver portions.

The characteristic instability of the St. John's riverbanks is attributed to the thick, unconsolidated glacial and post-glacial deposits and the large annual water-level fluctuations. Because the headwaters include very little lake storage, the river rapidly responds to rainfall and snowmelt. At the Dickey gauging station, average monthly flows for the period of 1971 to 1982 (USGS) ranged from 560 cfs in February to over 29,000 cfs in May, with high variability in late spring and summer flows. Most spectacular are the large spring flows, often accompanied by rafts of ice moving along the bank (ice drives) and ice-jam floods. Because the river flows northward, the upriver (southernmost) portions melt first; the flowing water then breaks up the ice in the downstream, still-frozen reaches. At Dickey and Ninemile, the two upriver gauging stations, ice-jam floods are common. Downstream at Fort Kent, ice-jams are rare, while spring high water and flooding are more common occurrences. At their most

severe, ice drives can completely denude portions of the bank, an effect seen fairly frequently on the upper St. John.

Lousewort habitat along the St. John River

The lousewort is restricted to the mainstem of the St. John River; lower flows and reduced ice action on its tributaries allow the development of dense vegetation to the water's edge, precluding preferred lousewort habitat. On the St. John itself, lousewort habitat is confined to the narrow band of eroding riverbank below the forest edge and above the river bed (Gawler et al. 1987) (Figure 5).

Louseworts grow almost exclusively on the north- or west-facing riverbank. Only a few small, isolated populations are known to be on the opposite bank. While reasons for this growth pattern are not completely clear, afternoon shade would appear to be an important factor. The amount of radiation able to reach the seedlings may also be critical, as they are in greatest abundance where competing vegetation is relatively sparse.

Substrate characteristics can have a profound effect on population dynamics. Most soils along the river are low in nitrogen and organic matter and high in calcium (Macior 1978b, Kite 1983), as expected for material that is primarily weathering glacial or post-glacial deposits. Pedicularis furbishiae occurs on glacial lacustrine or till deposits as well as on post-glacial overbank or vertical accretion deposits (Gawler et al. 1987).

Some populations grow on gravelly, unstable glacial drift, usually in the presence of groundwater seepage. These populations can be eliminated by bank slumping during high

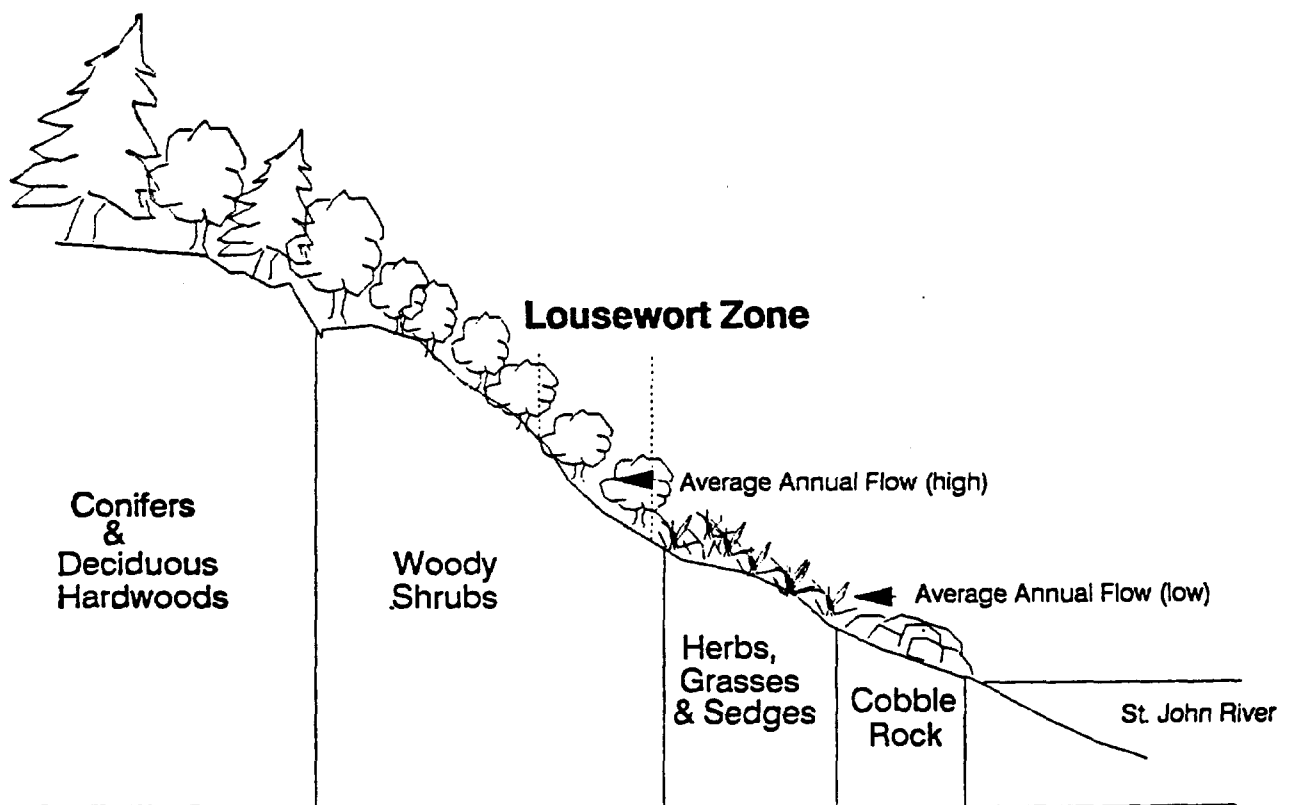


Figure 5. Riverbank profile

water (Menges et al. 1985). Others, especially downriver of St. Francis, grow on drier, more cohesive silty lacustrine or overbank deposits. These substrates dominate the lower part of Pedicularis furbishiae's range. Populations between Dickey and Allagash occur on lacustrine silt loams. Pedicularis furbishiae appears to be restricted more by the physical and successional characteristics of the riverbank than it does by soil chemistry or structure.

Analysis of 33 areas representing the range of riparian habitats along the upper St. John River has shown that lousewort habitat can be defined by four factors: louseworts tend to be found on steeper slopes, in wetter soils, in areas where the last catastrophic disturbance was 3-10 years ago, and/or in areas of high species richness (Gawler 1988). The last two factors are not independent; richness appears to peak about five years after a major disturbance, with a subsequent decline. Louseworts are generally absent from dense vegetation, such as grass-dominated shore meadows or tall, old shrub thickets, and from very open habitats, generally those with no woody vegetation or with all woody stems less than three years old.

Since the habitat is inundated or ice-scoured with each spring flood, the hydrologic regime strongly affects population dynamics. The narrow elevational range over which a population grows (often less than 2m) means that entire populations may be eliminated by an ice-scour event. Ice-scour and slumping also can be destructive to Pedicularis furbishiae individuals; nevertheless, these events are essential for maintaining the mid-successional habitat the species requires.

The frequency and size of ice drives and ice-jams, as well as the eroding glacially deposited banks of the St. John River, create a riparian habitat unique in the eastern United States.

Its flora includes the endemic Pedicularis furbishiae and several regionally rare, disjunct species from western North America and the Arctic (Table 2). The most common woody associates of the lousewort include alder (Alnus rugosa, A. crispa var. molle), willow (Salix spp.), red-osier dogwood (Cornus stolonifera), and bush-honeysuckle (Diervilla lonicera). Herbaceous associates include native species such as hemlock-parsley (Conioselinum chinense), northern painted-cup (Castilleja septentrionalis), Canada blue-joint grass (Calamagrostis canadensis), and several sedges (Carex spp.), as well as introduced species such as red clover (Trifolium pratense), vetch (Vicia cracca), and ox-eye daisy (Chrysanthemum leucanthemum) (Gawler 1988).

ECOLOGY: Life history and population dynamics

Pedicularis furbishiae is a herbaceous perennial which takes several years to reach sexual maturity. Reproduction is solely by seed. Louseworts flower from mid-July to mid-August, with seeds dispersing in early September. Flowering is determined by plant size (leaf area). At least three years, and often more, are required for a plant to grow to minimum flowering size. First-year flowering plants generally produce only one inflorescence, while older plants commonly produce up to five inflorescences. The largest plants can produce 25 or more inflorescences (Menges et al. 1986). The number of inflorescences produced is highly correlated with the plant's leaf area (Gawler et al. 1987).

Bombus vagans, a common bumblebee which also forages on other coflowering species such as red clover, is the exclusive pollinator of Pedicularis furbishiae (Macior 1978a). Recent experiments (Waller et al. 1988) have shown that selfed and

Table 2. Rare plants associated with Pedicularis furbishiae.

SPECIES	COMMON NAME AND STATUS
<u>Anemone multifida</u>	Northern thimbleweed S/T
<u>Arnica mollis</u>	Arnica
<u>Asarum canadense</u>	Wild ginger S/T
<u>Astragalus alpinus</u> var. <u>brunetianus</u>	Alpine milk-vetch
<u>Castilleja</u> <u>septentrionalis</u>	Northern painted-cup
<u>Equisetum variegatum</u>	Variegated scouring rush
<u>Gentianella amarella</u>	Felwort S/E
<u>Hedysarum alpinum</u> var. <u>alpinum</u>	Alpine hedysarum
<u>Juncus alpinus</u>	Alpine Rush S/T
<u>Listera auriculata</u>	Auricled twayblade F/C(3c)
<u>Oxytropis campestris</u> var. <u>johannensis</u>	St. John River loco-weed F/C(2), S/T
<u>Parnassia glauca</u>	Grass of Parnassus
<u>Phleum alpinum</u>	Mountain timothy S/T
<u>Prenanthes racemosa</u>	Racemed rattlesnake-root
<u>Primula mistassinica</u>	Bird's-eye primrose F/C (3c)
<u>Tanacetum bipinnatum</u> ssp. <u>huronense</u>	St. John River tansy S/T
<u>Tofieldia glutinosa</u>	False asphodel
<u>Viola novae-angliae</u>	New England Violet F/C(2)

F/C = Federal candidate (Category 2 or 3c)* species

S/E = State listed Endangered

S/T = State listed Threatened

- * A Category 2 species is defined as a species for which there is evidence of vulnerability, though there is not enough data to support listing.

outcrossed flowers are equally successful at setting capsules, contradicting Macior's (1978) conclusion that Pedicularis furbishiae is self-incompatible. Insufficient pollination rarely limits reproductive success, whereas inflorescence herbivory and seed parasitism often do (Menges et al. 1985, Gawler et al. 1986).

The success of capsule maturation varies widely among populations and years. On average an inflorescence will produce 7-17 capsules, each averaging 25 seeds (Menges et al. 1985, 1986; Gawler et al. 1986). Pre-dispersal herbivory of whole scapes by mammals (possibly deer, rabbits, and/or moose) is a major source of variation in seed production. Scape losses at the 12 populations sampled in 1984 ranged from 2% to 94%, averaging 26% (Menges et al. 1985). Pre-dispersal seed predation by larvae of the plume moth (Amblyptilia picta Wals) also influences reproductive output. The larvae feed on developing seeds inside the capsule, usually destroying all of them. Some larvae are attacked by parasitoid wasps, in which case the capsule will produce an average of four seeds (Menges et al. 1985). In 1984, 14% of maturing capsules were attacked by Amblyptilia picta. Herbivory and seed predation may have short-term effects on individual populations, but rarely threaten them over the long run. Capsules not eaten dehisce in autumn and the tiny seeds fall or are shaken out. The seeds appear to be dispersed by wind and water (Waller et al. 1988).

Seedlings emerge between late June and August. Most develop only two true leaves, generally about 1 cm long, during their first growing season (Gawler et al. 1987). Seedlings are most often found in moist microhabitats, such as moss-covered soil or parts of the bank which are constantly wet.

Like many in the snapdragon family, Pedicularis furbishiae is a root hemiparasite, and appears to be a host-generalist

(Macior 1980). In other Pedicularis species, parasitism may be important for obtaining water and minerals rather than carbohydrates (Sprague 1962). Minerals could be especially critical for Pedicularis furbishiae, given the very low fertility of the soils in which it grows (Macior 1978b). Greenhouse experiments conducted over a one-year period reveal that Pedicularis furbishiae is obligately hemiparasitic at least during the seedling stage. No haustoria (parasitic root connections) have been found on mature plants in natural populations (U.S. Fish and Wildlife Service 1983), but this could be due to the difficulty of excavating plants with intact haustoria (Piehl 1965). The ecological significance of hemiparasitism, i.e., whether it is a limiting factor for Pedicularis furbishiae, remains unclear.

While lousewort populations may be impossible to delineate on the ground, the "population"¹ can be understood conceptually. Pedicularis furbishiae is a fugitive species, succeeding in early- to mid-successional vegetation, and relying on disturbance to open up new areas for colonization. As such, understanding the cycles of population colonization, expansion and decline, and extinction are essential to planning its conservation. Detailed demographic studies undertaken between 1983 and 1987, simulation modelling using those data, and large-scale population censuses have provided some understanding of these processes (Gawler 1988, Gregory and Gawler 1990, Menges 1990).

The growth rate of a lousewort population depends largely on site characteristics, principally soil moisture and time since disturbance. Excluding effects of succession, populations on saturated soils grow most rapidly, those on moist soils grow

¹ For the purpose of this section, a population is defined in the biological sense as a group of potentially interbreeding individuals of the same species, i.e. the basic functioning unit of the species.

moderately fast, and those on dry soils grow slowly or even decline (Gawler 1988). This potentially explosive growth, especially of populations on saturated soils, does not, however, continue for long periods due to interacting effects of disturbance and succession.

When disturbance occurs in the form of scouring or slumping of the bank due to ice and water, it removes much of the vegetation. Louseworts rarely survive ice scour, and those that do are generally damaged since the overwintering bud is at the soil surface. Disturbance can destroy or severely decimate all or part of a population. In 1984, three of the seven populations censused in 1983 were completely destroyed by ice scour or slumping, a fourth was reduced by 95%, and a fifth by 75%.

Successional processes are as great a hazard to lousewort populations as natural disturbance. From 1985 to 1989, ice scouring was much less extensive and severe than in 1984. As a result, many stretches of habitat that had supported vigorous populations five years before had denser shrub vegetation and fewer louseworts in 1989 (Gregory and Gawler 1990). Accompanying a decline in numbers of individuals is a decline in reproductive output of individuals as succession advances. An individual plant's seed production is markedly lower at sites where the largest shrub stems are older than five or six years (Gawler 1988). Concurrently, seedling survival declines and reversions of reproductive plants to the vegetative state become more common (Gawler 1988). All of these factors reduce the population growth rate.

Pedicularis furbishiae appears to persist in the landscape in two different ways. Some populations, especially those on saturated soils, exhibit high population growth rates, and also have a high risk of extinction because of the instability of their wet, unconsolidated, gravelly substrate. There may

be high turnover rates of entire populations within this type of habitat. Populations on more stable, fine-textured deposits may demonstrate lower growth rates and have a lower risk of catastrophic extinction. Mortality data indicate that individual turnover is high, though population turnover may be lower than populations on wetter soils.

Simulation modelling of population dynamics (Gawler 1988, Menges 1990) reinforces the theory that lousewort populations persist mainly through local extinctions and recolonizations. The modelling results were supported by extensive stem counts conducted in 1980, 1984, and 1989 of the 48 river segments. For most segments, large changes were observed between 1980 and 1989; only four segments changed less than 50% over the nine years (Gregory and Gawler 1990) (Table 3). Large increases in number of flowering stems from 1980 to 1989 were particularly evident for segments in St. Francis and Fort Kent, while the greatest decreases were concentrated from the mouth of the Allagash River three miles downriver. However, the hallmark of lousewort population biology is fluctuation, so changes observed during the censuses can not be extrapolated to estimate future numbers.

Though large fluctuations of Pedicularis furbishiae flowering stems have been observed, the amount of available habitat, both occupied and potential, remains essentially the same over time (Table 4). Potential habitat, though it may have the right configuration, i.e., appropriate soil and moisture conditions, may not support lousewort populations at a particular time because of the successional stage of its vegetation or recentness of ice actions. Through time, potential habitat will evolve into an area suitable for lousewort populations. Occupied lousewort habitat in turn, may become unsuitable as conditions, in particular the increase in the density of woody vegetation or spring ice scour, change.

Table 3. Flowering stems, 1980-1989 (Gregory and Gawler 1990).

River Segment	Number Flowering Stems		
	1980	1984	1989
1	1		
2	86		114
3	65	608	380
4		100	4
5		251	49
7	228	50	
7N	6	0	0
8			152
9	65	579	418
10N		27	18
11N	65	75	3
12	11		
15-16	263	18	120
18	161	204	277
19-21	378	346	952
22	333	465	223
23-24	270	75	106
25	534	418	293
26	934	117	139
27	130	353	349
28	0		3
29	106	0	0
30	38	84	321
31	17		
33	132	104	453
35	143	351	373
37	414	156	950
40	649	447	1111
41	31	0	0
43	21	5	0
44	33	49	18

Table 4. Furbish lousewort habitat distribution (Gregory and Gawler 1990).

River Segment	Habitat (river miles)			
	Occupied	Potential	Unsuitable	Total
1				1.5
2	0.45	0.55	0	1.0
3	0.65	0	2.1	2.8
4	0.25	0.55	0.3	1.1
4N				0.3
5	0.8	0.75	1.45	3.0
6				2.5
7		≥1.5	≥0.5	3.3
7N	0	0	1.4	1.4
8	0.45	0	0.25	0.7
9	0.95	0.4	0.95	2.3
10				1.6
10N	0.2	0	0	0.2
11	0			1.6
11N				0.1
12		0.15	0.9	1.1
13				1.3
14				0.9
15	0.15	0.35	2.15	2.6
16	0.45	0	0.15	0.7
17	0	0	0.6	0.7
18	0.8	0	0.1	0.9
19	0.1	0	1.2	1.3
20	1.15	0	0	1.2
21	0.15	0	0.25	0.4
22	0.35	0.3	0.45	1.1

Table 4. Continued.

River Segment	Habitat (river miles)			
	Occupied	Potential	Unsuitable	Total
23	0.1	0	0	0.1
24	0.5	0	0.15	0.7
25	0.6	0.85	0	1.5
26	0.5	0	0	0.5
27	0.25	0	0.2	0.5
28	0.1	0.15	0.5	0.8
29	0	0	0.25	0.3
30	0.35	0	0	0.4
31	0	0	0.8	0.8
32	0	0.1	2.4	2.5
33	0.15	0	0	0.2
34	0	0	3.6	3.6
35	0.4	0	0.1	0.5
36	0	0	1.2	1.2
37	0.35	0.25	0.1	0.7
38	0	0	7.2	7.2
39	0	0	2.1	2.1
40	0.5	0	0.3	0.8
41	0	0.2	1.0	1.2
42				
43	0	0	0.25	0.3
44	0.3	0	0	0.3

THREATS

Any unnatural alteration to the St. John River ecosystem within the range of Pedicularis furbishiae constitutes a direct threat to the continued existence of the species. Two possible sources of adverse effects are (1) change in hydrology of the St. John River and (2) change in land use within and along the banks above lousewort habitat.

At the time the U.S. Fish and Wildlife Service officially listed the Furbish lousewort as endangered, the continued existence of the plant was threatened by the proposed Dickey-Lincoln School Lakes Hydroelectric Project. Congress deauthorized the Dickey-Lincoln School project on November 17, 1986, removing the greatest, most immediate threat to the species. Nevertheless, there are no prohibitions on the future construction of dams on the stretch of the St. John River from Big Rapids to Hamlin.

The cycle of intermittent disturbance by floods is crucial to the survival of the species. Damming free-flowing waters of the St. John would not only inundate some populations, but would affect all populations by preventing the ice scour and floods which now shape riverbank vegetation.

New Brunswick Power is still pursuing possible modification of the existing dam at Grand Falls, New Brunswick as well as the creation of an additional hydropower facility near Morrill, New Brunswick. Potential and known populations in Canada and the United States from Madawaska to Hamlin would be eliminated by implementation of these projects.

Aside from the continuing, albeit muffled, potential for dam construction on the St. John, widespread effects on lousewort populations resulting from changing land uses along the river

as well as from increased river flows are the major concern at this time.

Changes in land use on the banks of the St. John River have occurred through the clearing of vegetation, especially trees, for individual houselots, views, and agricultural fields. The removal of trees to the river's edge eliminates shade conducive to lousewort growth and reproduction, while the subdivision of the riverbank into residential and commercial building lots increases the difficulty of implementing conservation strategies. These land use practices within the St. John River watershed appear to affect Furbish lousewort habitat and populations.

In addition, there is evidence that the spring flows of the St. John River have been increasing since the 1940's (Menges and Gawler 1986), possibly due to excess runoff. Increased runoff (Gawler and Menges 1984), perhaps caused by accelerated timber harvesting within the watershed, may exacerbate the disturbance impacts to lousewort habitat. For instance, deforested areas can reduce the water retention capability of the watershed; increased river flows and resultant bank slumping may then eliminate habitat and populations at an artificially high rate.

Although the correlation between changes in land use and Furbish lousewort declines has not been established, there is cause for concern. Further research is necessary to determine the relationships between land use practices, effects on habitat, and lousewort population responses.

More localized activities such as direct habitat alteration and the burial of individual plants by the dumping of refuse and slash continue to be minor threats to particular lousewort populations. Impacts from all-terrain vehicle traffic and

bank use by recreationists may become threats as these activities increase in the area.

Currently, there are no laws preventing the destruction or removal of Pedicularis furbishiae plants. Federally endangered plant species are protected from "taking" if they occur on Federal land or if the destruction and/or removal is in knowing violation of a state endangered species law. None of the populations occur on Federal land, nor is there a Maine State law protecting endangered plant species. In lieu of legal protection of the plants, botanical collecting and/or vandalism could constitute threats to the species.

State shoreland zoning could provide some protection to Furbish lousewort habitat; however, the full strength of shoreland zoning protective measures has not been utilized. The Mandatory Shoreland Zoning Act (see Conservation Measures) does not specify Furbish lousewort habitat (or other threatened/endangered plant habitat) in any special category.

No lousewort habitat in the United States has been permanently protected, primarily due to the lack of opportunity for land or easement purchase by conservation agencies. A number of impediments have prevented protection of lousewort habitat either through direct habitat acquisition or conservation easements. The landownership patterns responsible for this lack of opportunity center on the division of lousewort habitat into relatively small, privately owned, residential lots (with the exception of Section 1). Further, the lack of willing sellers and landowners familiar with the need for -- and benefits of -- formal land protection make permanent protection of lousewort habitat difficult at best. In addition, the communities' unfamiliarity with the concept of conservation easements on privately-owned land may have hindered the donation and acquisition of easements or deed restrictions on lousewort habitat.

CONSERVATION MEASURES

A number of conservation measures have been initiated since the listing of Pedicularis furbishiae as endangered and through implementation of the initial recovery plan. The biological opinion issued by the Service on the proposed Dickey-Lincoln School Lakes Hydroelectric project was a major impetus to the deauthorization of the project (Appendix B) and the prevention of the destruction of a majority of lousewort habitat.

Canadian officials also recognized the need to protect the Furbish lousewort. The Canadian Committee on the Status of Endangered Wildlife formally declared the species to be endangered in Canada. On November 12, 1980, Provincial authorities also declared the lousewort to be an endangered species in New Brunswick, the first plant so designated. Since the plant's Canadian designation, a land trust in New Brunswick has purchased a small area containing louseworts.

Some protection of Furbish lousewort habitat is afforded under Maine State laws. The Maine Rivers Act of 1983 (MRSA 12, Sec 647-650) is a statewide rivers conservation act that identifies the most significant river segments in Maine. A portion of the St. John River is one of these segments. This act prohibits the construction of new dams on the St. John River from Baker Lake to one mile above Big Rapids in Allagash (encompassing all of Section 1). However, downstream of this area there are no prohibitions against new dam construction.

The Mandatory Shoreland Zoning Act (MRSA 38, Sec. 435) is a statewide law to protect shoreland areas along rivers and lakes. It provides additional, though minimal at best, protection for Furbish lousewort habitat by setting minimum standards for construction activities, timber harvesting, and

excavating within areas zoned as shorelands. Zoning ordinances within organized townships supersede those of the Shoreland Zoning Act, and are implemented by the municipalities themselves. The Maine Land Use Regulation Commission (LURC) implements shoreland zoning in unorganized townships. However, in many cases, the lack of enforcement of zoning ordinances precludes any protection afforded under this act.

The St. John River Resource Protection Plan applies to those areas of the St. John River that lie in unorganized towns. This plan is drawn up and agreed upon by LURC and landowners, and LURC implements the measures of this plan. To some extent, certain activities including building setbacks, timber harvesting, and land clearing are regulated within the shoreland areas (in which all of the Furbish lousewort can be found). The existing plan (a 10-year document renewable in 1992) is a land management plan and was drawn up prior to much of the research undertaken on lousewort. In the past, it provided very limited protection for lousewort habitat. The current draft of the 1992 plan focuses on recreational management and timber harvesting activities. Unfortunately, there are very few conservation planning measures that focus on Furbish lousewort protection.

The Maine State Critical Areas Program has been actively involved in the recovery of Pedicularis furbishiae for the past ten years. The Critical Areas Program identified and contacted all the landowners of significant lousewort populations. Fifteen of the most significant segments within the lousewort range have been officially recognized by the State of Maine, and listed on the Register of Critical Areas. Only voluntary landowner protection of the plant or its habitat is potentially afforded by this designation. An informational brochure on the Furbish lousewort, funded by the U.S. Fish and Wildlife Service, was written by the Maine

Critical Areas Program in 1986. The Critical Areas Program continues to contact and educate landowners and other residents within the Furbish lousewort range.

The U.S. Fish and Wildlife Service, through Section 6 funding, and the Army Corps of Engineers (as part of the Dickey-Lincoln proposal) have funded numerous life history and habitat ecology studies. C. Richards (1978, 1980) located additional populations, L.W. Macior (1978, 1980) studied pollination mechanisms and lousewort habitat parameters, and C. Wheeler (1980) worked on parasitism. Detailed demographic studies funded by the Fish and Wildlife Service, and in part by The Nature Conservancy, were conducted by S. C. Gawler, E. S. Menges, and D. M. Waller in 1983, 1984, and 1986. Extensive stem counts in 1984 (Gawler et al. 1986) and 1989 (Gregory and Gawler 1990) were also funded by the Service.

PART II: RECOVERY

RECOVERY OBJECTIVE

The objective of the recovery program is to reclassify the Furbish lousewort from endangered status to threatened by protecting and maintaining a reproducing population and its essential habitat¹ along the St. John River. Pedicularis furbishiae will be considered for reclassification when a geometric mean of at least 7,000 flowering stems is maintained for a six-year period, and 50% of the species' essential habitat is permanently protected².

To reclassify the Furbish lousewort, the population size should be above the minimum necessary to maintain a viable population. It is unknown what that minimum size may be; however, based upon previous population censuses (5,027 flowering stems in 1980, 4,882 flowering stems in 1984, and 6,889 flowering stems in 1989), it does appear that 7,000

¹ Due to the dynamic nature of the environment and the dependence upon disturbance to create the appropriate successional stage for lousewort habitat, essential habitat is defined as current lousewort habitat and/or potential lousewort habitat. This would exclude habitat that has been so altered by human intervention as to prevent the possibility of becoming lousewort habitat through natural evolution. In addition, habitat that does not demonstrate appropriate physical conditions (e.g., rock outcrops or flat, swale areas) or bank exposure also precludes being lousewort habitat.

²Habitat may be considered to be "permanently protected" by a number of different mechanisms. As an absolute minimum, the overall range of the lousewort needs to be protected from the threat of inundation or other major hydrological changes due to damming of the St. John River. Protective measures for portions of the essential habitat may be reached by direct acquisition, conservation easements, or deeded restrictions. In addition, these portions need to be available for management by public or private conservation agencies.

flowering stems will be sufficient to maintain a viable population (Thomas 1990).

Table 5 demonstrates a possible distribution of the amount of flowering stems and the protected essential habitat needed to initiate reclassification. This type of distribution is encouraged to prevent a concentration of plants and/or protected habitat within a limited area of the Furbish lousewort range.

Table 5. Suggested targets for flowering stem and habitat distribution.

River Section	Ave # Flowering Stems	Estimated Miles Protected Essential Habitat
Section 1 (Segments 1-16)	± 2100	3 to 5
Section 2 (Segments 17-30)	± 2100	2 to 4
Section 3 (Segments 31-41)	± 2100	U (at least 2)
Section 4 (Segments 42-44)	± 700	U

U = Unknown Some segments need to be walked to ascertain lousewort presence and distribution of essential habitat.

Until further data on the long-term population dynamics of Pedicularis furbishiae are available, a delisting objective is pending. The dynamic habitat of the Furbish lousewort contributes to the need for long-term studies.

RECOVERY ACTIONS TO ADDRESS THREATS

1.0 Protect Furbish lousewort populations and essential habitat.

Furbish lousewort populations and habitat are threatened by a variety of direct anthropogenic activities of recreational, developmental, and agricultural origin. Formal protection of essential habitat and, as a prerequisite, the education of landowners and land users need to be addressed.

1.1 Continue public outreach programs. Education of landowners, residents, and recreationists in communities within the range of the Furbish lousewort and its habitat will be intensified. Recovery activities such as acquisition of conservation easements and volunteer participation in conservation efforts are dependent upon an environmentally aware community.

1.11 Develop educational programs for presentation to communities, coordinate a river watch program, and institute school participation in river ecosystem conservation.

1.12 Maintain landowner contacts to promote voluntary protection agreements for essential habitat.

1.2 Determine all essential habitat in the four river sections. Survey previously unexamined areas to determine whether the habitat is suitable or has the potential to become suitable under appropriate conditions.

1.3 Strengthen State legal protection. A number of Maine State Acts could provide better protection of Furbish lousewort habitat if their potential were utilized and stronger amendments were added. Legal protection for eligible plants, including Pedicularis furbishiae, is also needed.

1.31 Encourage the development of an amendment to the Maine Rivers Act that would include the stretch of the St. John River that incorporates the entire range of the Furbish lousewort.

1.32 Encourage the development of an amendment to the Mandatory Shoreland Zoning Act that would provide enhanced protection for Furbish lousewort essential habitat.

1.33 Encourage the development of comprehensive State plant protection legislation. Currently, Maine does not have such legislation. A coordinated effort among public agencies and private conservation groups will be undertaken to develop and pass legislation that will provide legal State protection and enhanced Federal protection for threatened and endangered plants, including the Furbish lousewort.

1.4 Provide permanent land protection for essential habitat. Direct protection of the Furbish lousewort and its habitat can be accomplished through acquisition or conservation easements.

1.41 Attempt to secure title or conservation easements for at least 50% of the essential habitat within each of the four river sections

(see Table 5). Encourage acquisition through purchase or gift to private or public conservation agencies from willing landowners. Where appropriate, set up protective management agreements or develop applicable deed restrictions.

1.42 Encourage the establishment of local land trusts to coordinate and administrate easements, agreements, and deed restrictions.

2.0 Monitor population trends and condition of essential habitat.

Population trend analysis will determine the health and reproductive status of the population. Biennial monitoring of the population (flowering stems) and essential habitat will be conducted to ascertain when the recovery goal is reached.

3.0 Coordinate activities with local, regional, State, and other regulatory agencies.

The conservation of the Furbish lousewort and the protection of its habitat are responsibilities shared by many entities. The effective implementation of the recovery plan will require coordination between numerous agencies, organizations, and individuals.

3.1 Coordinate with the Maine Department of Environmental Protection to monitor the effectiveness of shoreland zoning in protecting Furbish lousewort essential habitat. Coordination is necessary to ensure the effectiveness of shoreland zoning in the protection of Furbish lousewort.

- 3.2 Coordinate with the Maine Land Use Regulation Commission (LURC) with the revision, renewal, and implementation of the St. John River Resource Protection Plan. The St. John River Resource Protection Plan is under revision. Coordination is necessary to ensure both the renewal of the plan and that the plan addresses protection of lousewort populations and essential habitat.
- 3.3 Coordinate with the Maine Office of Comprehensive Planning to incorporate protective measures in town plans and ordinances. Essential habitat protection should be included in town comprehensive plans for the organized townships within the lousewort's range. Compatible local zoning ordinances should be developed, with full consideration given to protecting the St. John's riverbanks.
- 3.4 Coordinate with Federal agencies to ensure the continuation of present-day dynamics of the St. John River ecosystem within the Furbish lousewort's range. Any alteration of natural processes of the St. John River in the areas of established populations and essential habitat would be a serious threat to the species' continued existence. Possible threats include the construction of water impoundments on any stretch of the river within the Furbish lousewort range and/or activities that would artificially regulate the river's hydrology. The U.S. Army Corps of Engineers, Federal Energy Regulatory Commission, or any other Federal agency either (1) authorized by Congress to undertake specific projects in the St. John Valley or (2) responsible for issuing or authorizing permits to carry out private actions that could affect the

Furbish lousewort must comply with the provisions of Section 7 of the Endangered Species Act.

3.5 Maintain international cooperation. Joint protection efforts, including cooperation between the Maine Critical Areas Program and the New Brunswick Ecological Reserves Program, will be coordinated between the United States and Canada. Of particular concern is the possible modification of the hydropower facilities at Grand Falls, New Brunswick. Any modification and/or change in the power pool at Grand Falls could have a significant impact on upstream and downstream populations and would include coordination with the International Joint Commission.

4.0 Assess threats to the recovery of the Furbish lousewort. Direct impacts to the Furbish lousewort such as habitat alteration, as well as indirect impacts such as land use alteration affecting the St. John River's hydrology, need to be assessed to determine appropriate recovery actions.

4.1 Determine the possible correlation between current land use practices and hydrologic responses of the upper St. John River. The relationship between shoreline activities and the hydrologic regime of the river will be studied. Increased runoff due to agricultural and forestry practices, particularly land clearing, may amplify river flows during flash events, causing increased disturbance to lousewort habitat or elimination of populations at an unnaturally high rate.

4.2 Determine the correlation of land use in the St. John river corridor to lousewort distribution and abundance. Using information based on completion of

Task 4.1 and identifying agricultural, residential and commercial locations along the river corridor, investigate the potential for these land uses to affect lousewort habitat, distribution, and abundance.

4.3 Assess the potential impact of recreational activities on the Furbish lousewort. Research will be conducted to determine whether recreational activities, such as the trampling of lousewort plants or the degradation of its habitat from recreational activities (e.g., all-terrain vehicle use), adversely affect Furbish louseworts and their habitat.

5.0 Study recolonization processes.

Furbish lousewort habitat undergoes succession and is altered by ice scour and flooding events. Recently disturbed and unoccupied potential habitat will be monitored to determine the rate of recolonization by louseworts.

6.0 Develop appropriate management recommendations on a site-specific basis for *Pedicularis furbishiae*.

Management recommendations will be developed and implemented, as needed, in areas of Furbish lousewort essential habitat that have been protected through conservation easements, management agreements, or direct land acquisition.

6.1 Manage succession within specific portions of lousewort habitat. Determine whether the removal of woody vegetation will enhance lousewort habitat undergoing later stages of succession. If habitat manipulation is deemed necessary, management plans will be devised and applied to protect existing and,

if warranted, newly established populations (see Task 7).

6.2 Manage public use of the river banks to protect the Furbish lousewort and its habitat. Based upon the results of Task 4.3, appropriate management strategies such as designated access paths to the river will be implemented.

7.0 Establish and initiate management of new populations. Populations represent individual occurrences for the purposes of this task. Establishing new populations, contingent on information gathered from monitoring surveys and life history studies, may be necessary to safeguard the species from unforeseen natural disasters and human impact. This task will be implemented if Tasks 5.0 and 6.1 show that additional occurrences are possible to establish and/or warranted.

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- Waller, D.M., D.M. O'Malley, and S.C. Gawler. 1988. Genetic variation in the extreme Pedicularis furbishiae (Scrophulariaceae). *Conserv. Biol.* 1: 335-340.
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IMPLEMENTATION SCHEDULE **Furbish Lousewort**

First Revision, June 1990

Priority	Task Description	Task Number	Duration	Responsible Agency		Costs (\$000)			Comments
				USFWS	Other	FY1	FY2	FY3	
1	Continue public outreach programs.	1.1	Ongoing		SA, PO	8	12	7	+ 5,000/yr for FY 4-6.
1	Permanently protect essential habitat.	1.4	Ongoing		SA, PO	8	8	8	+ 8,000/yr for FY 4-6. Includes cost of easements on 70-100 acres of habitat.
2	Determine essential habitat in all river sections.	1.2	2 years	FWE	SA, PO	2			+ 2,000 more in FY 4.
2	Strengthen State legal protection.	1.3	Ongoing		SA, PO				
2	Monitor population and habitat conditions.	2.0	Every 2 years	FWE	SA, PO	5		5	+ 5,000 more in FY 5.
2	Coordinate with Maine LURC.	3.2	1 year		SA, PO				
2	Coordinate with State and local planning agencies.	3.3	2 years		SA, PO				
2	Maintain international cooperation.	3.5	Ongoing	FWE	SA, PO				
2	Study recolonization processes.	5.0	3 years		SA, PO	1.5	1.5	1.5	
2	Manage succession at specific sites, as needed.	6.1	5 years	FWE	SA, PO		4	2	+ 2,000/yr for FY 4-6.
2	Manage public use of river banks.	6.2	3 years		SA, PO			2	+ 2,000/yr for FY 4-5.
3	Coordinate with ME DEP regarding shoreland zoning.	3.1	Ongoing		SA, PO				
3	Coordinate with Federal regulatory agencies.	3.4	Ongoing	FWE	COE, FERC				

Priority	Task Description	Task Number	Duration	Responsible Agency		Costs (\$000)			Comments
				USFWS	Other	FY1	FY2	FY3	
3	Coorelate land use practices with river flow response.	4.1	3 years		SA, PO		1.5	1.5	+ 1,500 in FY 4.
3	Correlate land use and lousewort demography.	4.2	2 years		SA, PO		1.5	1.5	
3	Assess recreational impact on habitat.	4.3	2 years		SA, PO	1	1		
3	Establish and manage additional populations, as warranted.	7.0	6 years	FWE	SA, PO	2	2	2	+ 2,000/yr for FY 4-6.

APPENDIX A

1983 RECOVERY PLAN STRATEGIES

1983 Recovery Plan Strategies

Task	Recovery Activities	Completion	Comments
1.1	Extend existing congressional moratorium on hydro projects	Partially completed	Final moratorium did not include entire lousewort range
1.2	Implement the 1982 St. John River Resource Protection Plan	Completed	Revision of plan due 1992
1.3	Review community zoning standards for shoreline protection	Not Completed	Addressed in revised Plan
1.4	Insure all Federal agencies comply with Endangered Species Act directives	Ongoing	" " "
2.1	Determine ownership of all extant colonies	Completed	Update necessary
2.2	Designate state critical areas and encourage landowner conservation	Completed	Addressed in revised Plan
2.3	Secure formal protection agreements for the most significant colonies	Not Completed	" " "
2.4	Conduct general information and education efforts	Ongoing	" " "
3.1	Conduct periodic surveys and develop population estimates	Ongoing	" " "
3.2	Conduct quantitative analyses at six specific colonies	Completed	
4.1	Research nutritional needs	Completed	
4.2	Assess severity of insect infestations	Completed	

1983 Recovery Plan Strategies

Task	Recovery Activities	Completion	Comments		
4.3	Determine colonies' riverbank elevation relative to flows	Not Completed	Addressed in revised Plan		
4.4	Assess annual flow regime's significance to lousewort ecology	Not Completed	"	"	"
5.0	Conduct habitat survey	Not Completed	"	"	"
6.0	Establish additional lousewort colonies	Not Completed	"	"	"
7.0	Develop management recommendations for each colony	Not Completed	Recovery activity revised and addressed in Plan		
8.1	Contact local and regional planning organizations	Ongoing	Addressed in revised Plan		
8.2	Establish and maintain international cooperation	Ongoing	"	"	"

APPENDIX B

DICKEY-LINCOLN SCHOOL DAMS BIOLOGICAL OPINION



United States Department of the Interior

FISH AND WILDLIFE SERVICE

WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

JUN 27 1978

In Reply Refer To:
FWS/OES 375.0

Lieutenant General J.W. Morris
Chief of Engineers
Department of the Army
Washington, D.C. 20314

Dear General Morris:

This responds further to the Corps of Engineers May 5, 1978, request for Section 7 consultation pursuant to the Endangered Species Act of 1973 on the proposed Dickey-Lincoln School Lakes project and its impacts on the Endangered Furbish lousewort (Pedicularis furbishiae).

The Corps' New England Division Office has previously consulted on the proposed project relative to its impacts on the bald eagle, Eastern cougar and peregrine falcon. Those consultations were carried out by our Regional Office in Newton Corner, Massachusetts. The letters from the Corps requesting the consultations and our Regional Director's biological opinions are enclosed for your information.

In response to the Corps' May 5 request, I appointed a consultation team by letter of June 6, 1978 (copy enclosed), to assist me in determining whether the proposed Dickey-Lincoln School Lakes project is likely to jeopardize the continued existence of the Furbish lousewort. The team was comprised of Mr. Robert Jacobson, Chief of the Management Operations Branch, Office of Endangered Species (OES); Dr. Paul Opler, Acting Chief of the Biological Support Branch, OES; Mr. Ronald Lambertson, Assistant Solicitor, Office of the Solicitor; Mr. Paul Nickerson, Endangered Species Coordinator, Newton Corner, Massachusetts; Mr. Richard Dyer, Endangered Species Botanist, Newton Corner, Massachusetts; Mr. Brian Kinneer, Endangered Species Staff, Newton Corner, Massachusetts; and Mr. Robert Currie, Fisheries Biologist, Concord, New Hampshire.

On June 15, 1978, the consultation team met with your representatives to discuss the proposed project and its anticipated effects on the lousewort. At this meeting, "Mr. Ronald Lambertson was unable to attend but Mr. Donald Barry of the Office of the Solicitor was present in his place. A list of the participants is enclosed".

As you may be aware, your New England Division Office previously requested Section 7 Consultation on this project on November 24, 1976. Because the lousewort was not listed at that time, formal consultation was not possible. However, the Corps and the Service entered into an informal consultation process which continued until final listing of the lousewort as Endangered. In this regard, the Corps is commended for its continuing cooperative efforts in conducting necessary studies and field inventory work to obtain information essential to determining the anticipated effects of the project on the lousewort. This data proved to be extremely useful to the consultation team by providing essential information on which to base the Service's biological opinion.

The consultation team reviewed information contained in the Draft Environmental Impact Statement (DEIS) entitled "Dickey-Lincoln School Lakes, Maine, U.S.A. and Quebec, Canada", and other information provided by the Corps, academic and private sources or available within the Service. Information in the DEIS was carefully evaluated to ascertain the anticipated effects of the proposed project in terms of onsite impacts and impacts downstream from the project on the lousewort. Copies of pertinent reports and documents are included in an administrative record maintained in the Office of Endangered Species and are incorporated by reference.

The proposed project is located in northern Aroostock County, Maine and if implemented would provide a source of electricity to meet the anticipated power needs of New England. The project consists of two dams. The Dickey Dam, located on the upper St. John River immediately above its confluence with the Allagash River, would be an earthfill structure having a total length of 10,300 feet and a maximum height of 335 feet. The Lincoln School Dam would be located 11 miles downstream from the Dickey Dam, and would be 2,200 feet long and 95 feet high. The Lincoln School Dam's principle purposes would be regulate peaking power releases from the Dickey Dam and provide an additional power source. The Dickey-Lincoln School Dam project would inundate approximately 28,000 acres of land and 267 miles of streams including 55 miles of the St. John River.

After careful review of the findings by the consultation team, it is my biological opinion that the Dickey-Lincoln School Lakes project, as presently planned, is likely to jeopardize the continued existence of

the Furbish lousewort unless the conservation program recommended in this opinion is initiated and successfully carried out by the Corps in consultation with and with the assistance of the Service. This biological opinion is based on the information sources cited above concerning possible effects of the proposed project on the lousewort.

A summary of the biological data considered during this consultation is provided below:

The Furbish lousewort (*Pedicularis furbishiae*) was determined to be Endangered and was added to the U.S. List of Endangered and Threatened Wildlife and Plants on April 26, 1978, (43 FR 17910-17916). Critical Habitat has not yet been determined. Previously thought to be extinct (it had not been collected since 1943), the Furbish lousewort was rediscovered in the course of an environmental study by Dr. C.C. Richards under contract to the Corps. The Furbish lousewort occurs along 160 miles of the main stem of the St. John River from the project area, Aroostook County, Maine downstream to the mouth of the Aroostook River in New Brunswick, Canada. Within this range, approximately 879 plants have been found at 21 stations. The plants almost always are found in a narrow zone just above the river itself. This zone is usually on partially shaded north, northeast, or northwest facing slopes.

In the final rulemaking, prepared by the Service, in which the lousewort was listed as Endangered, the Corps' proposed Dickey-Lincoln School Lakes project, dumping, natural landslides, construction and lumbering were cited as endangering factors. The Dickey-Lincoln School Lakes project, if constructed, would inundate 353 plants at 13 stations over 35 miles of the plant's range. Within the 70 mile zone downstream from the proposed project, 162 plants at five stations are jeopardized by dumping of refuse over river banks, construction and other stream bank modifications. The 364 plants at three stations along 20 river miles in Canada are jeopardized by a proposed impoundment.

Various aspects of the lousewort's reproductive and population biology are of critical importance in the consideration of possible conservation programs for the Furbish lousewort. Of primary concern is the fact that natural establishment of new lousewort colonies may depend upon prior disturbance of river banks, by either flooding or landslides. Artificial establishment of new colonies is dependent upon knowledge of possible hemiparasitic relationships, transplant techniques, and seedling establishment. Furbish lousewort appears to be an obligate outbreeder, hence the presence of appropriate bumblebee (*Bombus vagans*) populations is necessary to ensure appropriate seed set and genetic variability of progeny. The reports and studies which provided much of the above biological data are a part of the administrative record maintained in the Office of Endangered Species.

Conclusion

Based on my consultation team's review of the above information and other information and data available to the Service, it is my biological opinion that the Dickey-Lincoln School Lakes project, if constructed as planned, is likely to jeopardize the continued existence of the Purbish lousewort. However, if the Corps develops and implements successfully the following conservation program, in consultation with and with the assistance of the Service, the continued existence of this Endangered species is not likely to be jeopardized as defined in Section 402.02 of the Inter-agency Cooperation Regulation published in the Federal Register on January 4, 1978. The Conservation program must include, at a minimum, the following:

1. Development of information which will lead to a functional understanding of the habitat needs and propagation techniques of the Purbish lousewort.
2. Acquisition and protection of existing habitats below the project impoundment area currently supporting lousewort populations.
3. Acquisition of habitat identified as capable of supporting new populations of louseworts.
4. Establishment of new, self-sustaining colonies through transplantation, seeding or other appropriate techniques.
5. Obtaining better information on what the effects will be of downstream flows, after construction of the project, on the lousewort and its habitat.
6. Development of a monitoring program which will be capable of detecting any changes in lousewort biological status, such as habitat changes, population increases or decreases, and microclimatic conditions.

If as a result of the conservation program, new information is revealed that was not considered during this consultation, or prior to implementation of recommendations 2, 3, or 4 above, the project is modified or a new species is listed in the project area, Section 7 Consultation must be reinitiated. Further, the Corps should not make any irreversible or irretrievable commitment of resources which would foreclose the consideration of modifications or alternatives to the proposed project during the development and successful implementation of the recommended conservation program.

The Corps also asked for a clarification of the Solicitor's opinion dated July 14, 1977, concerning mitigation and Section 7. In particular, the Corps was concerned about the impact of that opinion on the Corps' conservation responsibilities for the Purbish lousewort. The Solicitor's Office has developed such a clarification, and a copy will be forwarded under separate cover.

Again, I want to express the Service's gratitude to the Corps for their efforts to meet responsibilities under the Endangered Species Act of 1973. Should you desire clarification of items in this opinion or desire further assistance, we will be pleased to respond promptly. Also, should the Corps desire to initiate the recommended conservation program, the Service stands ready to assist and provide further Section 7 Consultation.

Sincerely yours,

(SGT) Lynn A. Greenwalt

Director

Enclosures

cc: Directorate Reading File
DD Chron
AFA File

FWS/OES:RJacobsen:eb:mas 6/26/78
FWS/AFA:HO'Connor:ba 6/27/78 (revised)

For Further Information, contact:

**Endangered Species Biologist
U.S. Fish and Wildlife Service
22 Bridge Street
Concord, New Hampshire 03301**

APPENDIX C

LIST OF REVIEWERS

The following individuals provided comments on the draft recovery plan. Their comments were incorporated, as appropriate, into the final plan.

Dr. Susan C. Gawler
Maine Natural Heritage Program
State House Station 130
Augusta, Maine 04333

Linda Gregory
5 Bowles Avenue
Bar Harbor, Maine 04609

Dr. Harold Hinds
Botany Department/Herbarium
University of New Brunswick
P.O. Box 4400
Frederickton, New Brunswick
Canada

Dr. Eric Menges
Archbold Biological Station
P.O. Box 2057
Lake Placid, Florida 33852

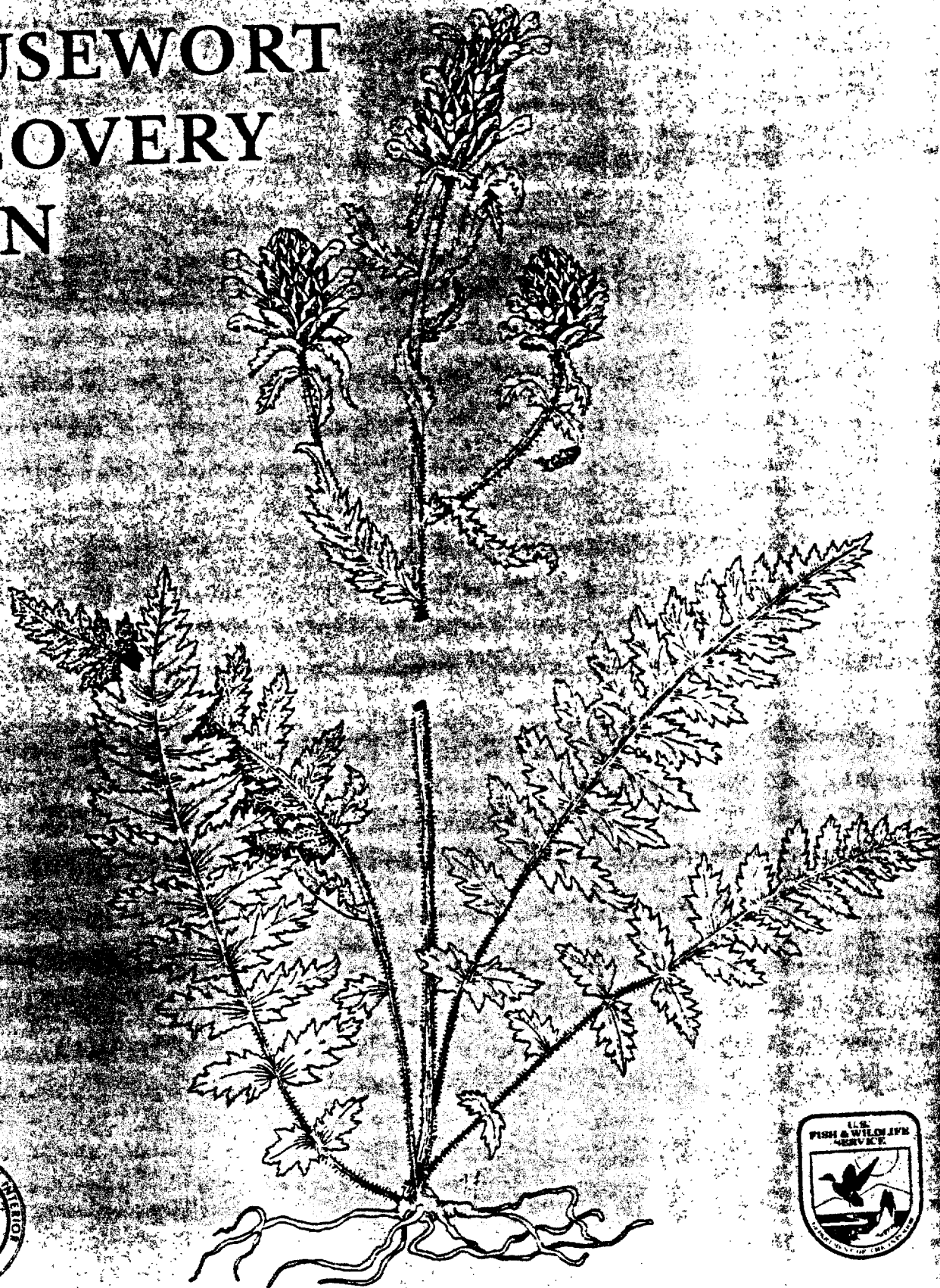
Patricia O'Brien
P.O. Box 87
Perth-Andover, New Brunswick
Canada

Hank Tyler
Maine Critical Areas Program
State House Station 38
Augusta, Maine 04333

Barbara Vickory
The Nature Conservancy
P.O. Box 338
Topsham, Maine 04086

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495
345100

WETLAND LOUSEWORT RECOVERY PLAN



FURBISH LOUSEWORT
RECOVERY PLAN



Prepared By:

Richard W. Dyer

Region 5 of the U.S. Fish and Wildlife Service



APPROVED

DATE:

June 29, 1983

U.S. FISH AND WILDLIFE SERVICE:

Howard M. Lamm

Regional Director, Region 5

This is the completed Furbish Lousewort Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent the official position or the approval of cooperating agencies. The plan has been prepared by the U.S. Fish and Wildlife Service to delineate reasonable actions which we considered necessary for the recovery of the species. This plan is subject to modification as dictated by new findings and changes in species status and completion of tasks assigned in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities and other budgetary constraints.

Acknowledgements should read as follows:

The Furbish Lousewort Recovery Plan, dated June 1983 prepared by the U.S. Fish and Wildlife Service.

Additional copies may be obtained from:

Fish and Wildlife Reference Service
Unit i
Denver, Colorado 80205
Telephone: 303/571-4656

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Cover Illustration - by Tess Feltes

Part I

Introduction

Description

The Furbish lousewort (Pedicularis furbishiae S. Watson) also called the St. John River wood-betony, is a perennial herb of the snapdragon family (Scrophulariaceae) which is endemic to the St. John River in Northern Maine and New Brunswick, Canada. The plants are 4-9 decimeters tall and are usually covered with short but conspicuous silvery-white hairs. The fern-like leaves are stalked, lance-shaped, deeply divided and alternately arranged on a dark red stem. Each leaf segment is shallowly lobed or toothed and has silvery margins. The greenish-yellow flowers occur in a terminal spike-like cluster. The calyx has five unequal lobes and the corolla is two-lipped. The upper lip of the corolla is straight and lacks a conspicuous beak typical of some other louseworts. The lower lip is erect and three-lobed at the tip. The bracts are egg shaped and toothed. The fruit is a roundish capsule about 1.2 centimeters long.

The genus Pedicularis presumably had its origin in the Himalaya Mountains, dispersing throughout Eurasia and the Bering Strait to North America, evolving new species as it spread. The evolution of Pedicularis furbishiae is not fully understood but the species is significantly different from the other two eastern North American species of Pedicularis in terms of habitat requirements, blooming phenology, structure and pollination mechanisms.

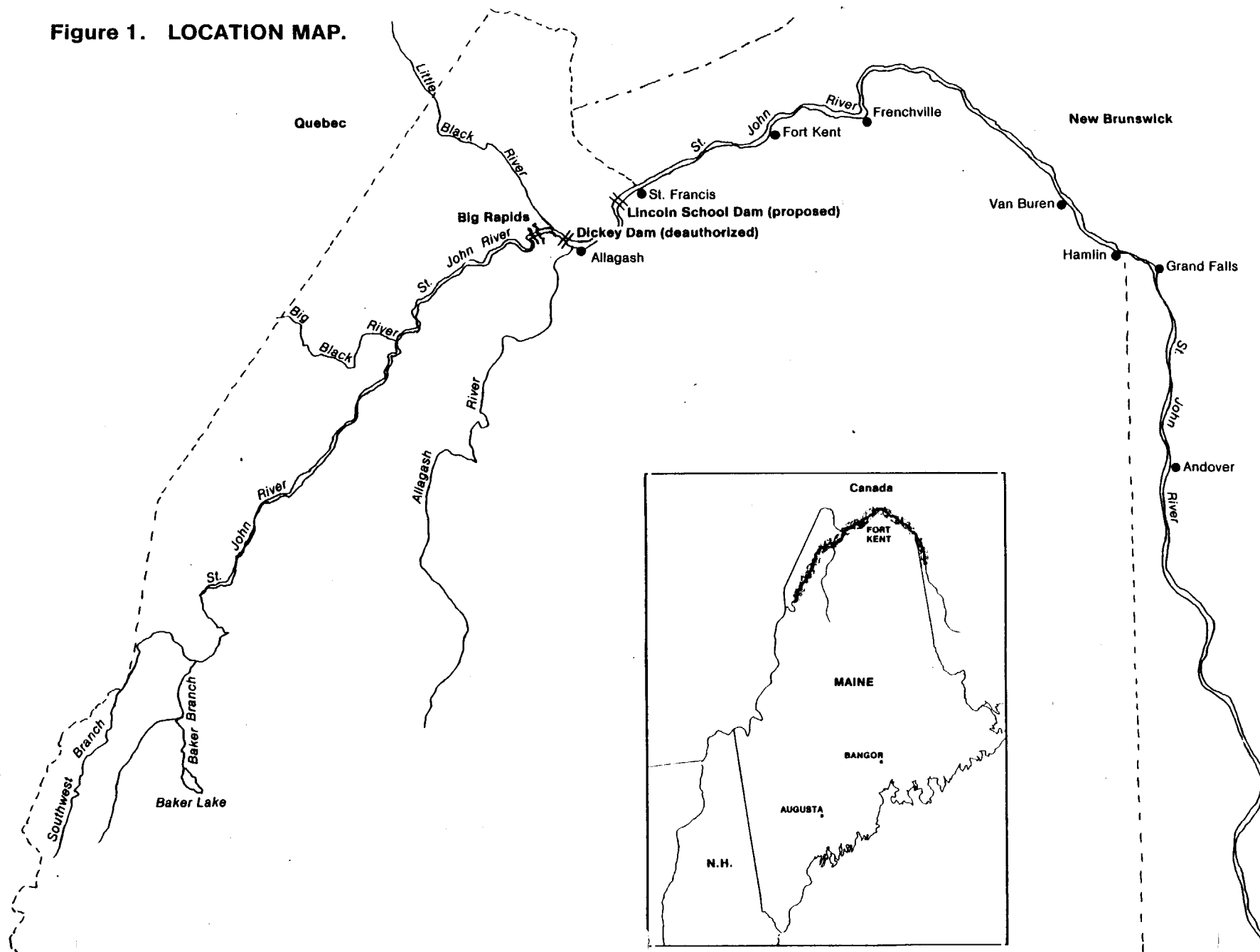
Distribution

The Furbish lousewort, which has the most restricted geographical distribution of over 500 species in the genus Pedicularis, was first collected along the banks of the St. John River in Van Buren, Maine by Kate Furbish in 1880. The species was described by Sereno Watson in 1882. Most collections of Pedicularis furbishiae were made in the late 1800's and the early 1900's in the towns of Van Buren, Frenchville, Fort Kent, St. Francis and Allagash, Maine. Other early collections were made in Grand Falls and Andover, New Brunswick. Interestingly, two Canadian specimens were collected near Grand Falls, New Brunswick in 1878 and 1879 but were misidentified at the time and not correctly identified until many years later.

Throughout the past century the St. John River in northern Maine and many other rivers in eastern Canada have been surveyed during various botanical expeditions. Herbarium specimens from 1880-1946 indicate the Furbish lousewort was confined to approximately 140 miles of the St. John River from Andover, New Brunswick upstream to the confluence of the Big Black River (Fig. 1). There is no known record of occurrence for Pedicularis furbishiae anywhere outside of this area.

Until recently (1976-1981), the last collections of the Furbish lousewort were made in 1943 in New Brunswick and 1946 in Maine. The Smithsonian Institution listed Pedicularis furbishiae as "probably extinct" in its December 1974 report to Congress, entitled "Report on Endangered and Threatened Plant Species of the United States." However, in July of 1976, Dr. Charles

Figure 1. LOCATION MAP.



Richards of the University of Maine located seven colonies of Pedicularis furbishiae while conducting a rare plants survey on the St. John River for the U.S. Army Corps of Engineers. The rare plants survey was done in preparation of the Environmental Impact Statement for the proposed Dickey-Lincoln School Lakes Hydroelectric Project authorized by Congress in 1965.

Abundance

The U. S. Fish and Wildlife Service officially listed the Furbish lousewort as an endangered plant species on April 26, 1978. Due to the Dickey-Lincoln project's potential impact on the Furbish lousewort, the Corps of Engineers, the Fish and Wildlife Service and a group of United States and Canadian scientists initiated a series of intensive investigations to further determine the species' status and biological requirements.

As a result of these studies (1976-1981) 28 colonies of the Furbish lousewort are now known to exist. Twenty-five of these colonies are in Maine, nineteen of which were within the proposed Dickey-Lincoln impoundments. (Note: The limits of a colony are somewhat arbitrary and principally based on recognizable geographical features-- islands, tributaries, named river rapids, etc. Colonies can be adjacent to one another but are often separated by several miles of riverbank where louseworts do not occur.)

During the 1977 and 1980 field surveys, much of the upper reaches of the St. John mainstem, segments of all major tributaries, and all of the St. John from Allagash downstream to the international border

in Hamlin, Maine were intensively surveyed by experienced botanists. It proved difficult to accurately determine the number of plants along 140 miles of river and the surveys have, at best, provided a rough estimate of the total lousewort population. Such factors as accessibility, time demands, the inability to locate individual lousewort plants in dense riverbank vegetation, the obscurity of seedlings, and the difficulty of accurately counting the number of seedlings and mature plants in a dense colony all influence population estimates. Based on the geographical thoroughness of the 1980 surveys, in which only flowering stems were counted, a total population estimate of approximately 5,000 individual plants does not appear unreasonable. This estimate considers a 1:1 relationship between flowering and non-flowering plants; 2.5 flowering stems per plant and an additional 20 percent for colonies that may not have been observed. Although the species is distributed along 140 miles of river, 72 percent of the total known population occurs in the towns of Allagash and St. Francis along approximately 12 miles of riverbank.

Habitat Requirements

All but three of the 28 known colonies occur on the north facing riverbank where the louseworts are shaded by red spruce (Picea rubens), white spruce (Picea glauca), balsam fir (Abies balsamea) and various northern hardwoods at the top of a broad sloping bank. Mature louseworts seem to prefer areas which receive only partial sun during the day. The significance of light tolerance is apparent but not fully understood. The vegetation along the banks is very dense and may limit seedling establishment. In full sunlight the amount of solar radiation on lousewort seedlings and the basal rosette of mature plants is only ten

percent of that reaching ground level in open areas. The amount of radiation able to reach the seedlings may be critical as they are in greatest abundance where the competing vegetation is relatively sparse. In addition, the roots of competing vegetation are often so dense in the upper soil profile that they appear to physically limit the establishment of lousewort seedlings.

The Furbish lousewort has a preference for well-drained, sandy loams which are generally low in nitrogen but high in calcium. Soil samples analyzed in 1977 were slightly acidic and varied widely in physical composition and chemical constituents. This indicates the species is not particularly restricted by edaphic characteristics and might do quite well in a variety of soils originating from glacial outwash. Soils along the St. John River are typically very thin. Roots of mature louseworts penetrate 2 - 2.5 inches and extend approximately 10 inches from the crown.

The dramatic fluctuations in the annual flow of the St. John River appear to be a critical factor in maintaining suitable lousewort habitat. Using 1946-1979 data, average annual flow extremes at Dickey, Maine range from 51,106 CFS to 384 CFS. Maximum flows are usually associated with the spring thaw; however, several days of heavy summer rain have caused some of the highest flows on record (August 7, 1981 - 77,000 CFS). High spring flows in combination with breaking of the ice pack cause the riverbanks to be intermittently ravaged. Because of these abrasive forces, woody vegetation on the sloping banks where louseworts occur is predominantly downy alder (Alnus viridis subsp. crispa), bush honeysuckle (Diervilla lonicera) and red-osier dogwood (Cornus stolonifera). Louseworts are

most abundant on the edge of the alders, in the transition zone between the alders and the herbaceous cover which extends to the water's edge (Fig. 2).

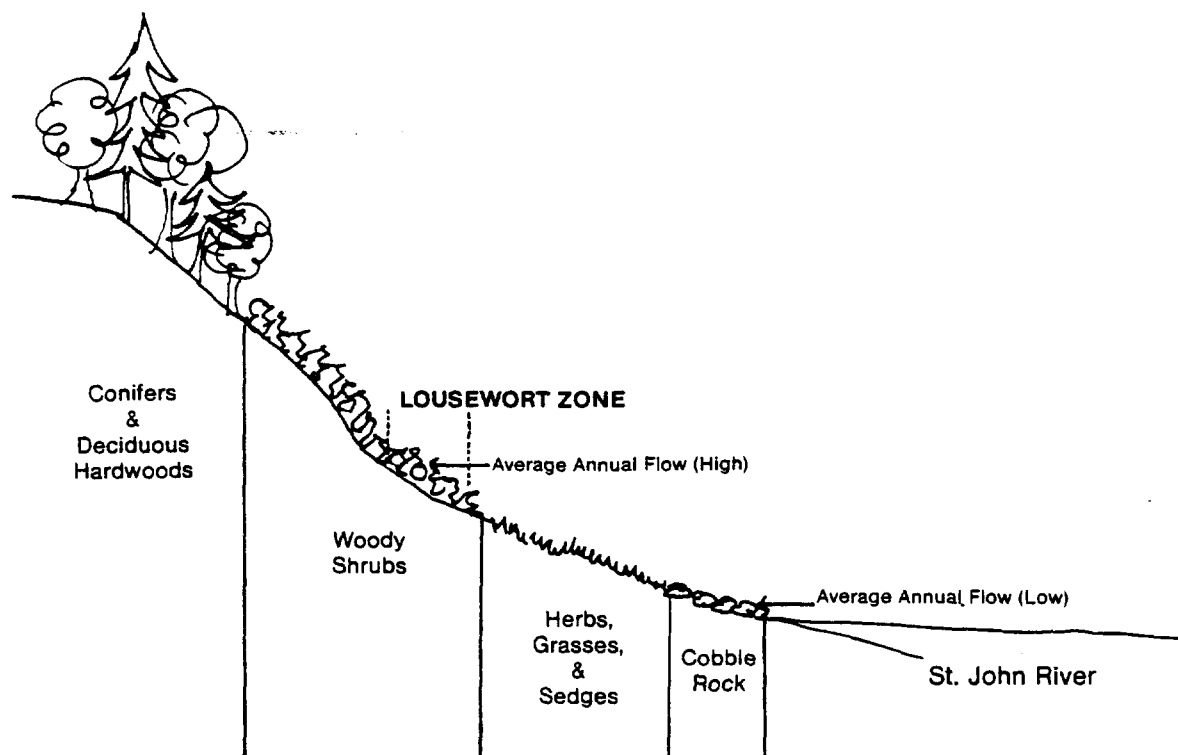


Figure 2. RIVERBANK PROFILE.

The hydrological character of the St. John mainstem is in marked contrast to its many tributaries. The tributaries are not subjected to the same extreme forces of flow and dense woody vegetation is established to the water's edge. In many intensive searches of these tributaries lousewort colonies have never been found. Although the specific role flow fluctuations play in the lousewort's life requirements cannot be stated with certainty, intuitive judgement cannot escape the conclusion of its significance to habitat maintenance.

Species Biology

Louseworts flower from mid-July to mid-August with seeds dispersing in early September. The production of viable seed is sufficient to assure a high reproductive potential and the observed ratio of 1:1 for adults to seedlings may be the result of the factors discussed earlier. Studies using insect exclosures and artificial pollination have determined that the Furbish lousewort is self-incompatible and obligately insect pollinated. Although four different species of bumblebee have been observed foraging in the vicinity of lousewort colonies only one species of bumblebee, Bombus vagans workers, actually pollinate lousewort flowers. The plant's only known method of reproduction is by seed. Seed germination apparently requires a dormant period of chilling or freezing. The seed must also germinate the spring following maturity since most seeds retained in experimentation more than a year lost viability.

The most intriguing aspect of the Furbish lousewort's biology involves the species' nutritional requirements and possible symbiotic association with other plants. The other two eastern United States species of lousewort,

Pedicularis canadensis and Pedicularis lanceolata, are both known to be root hemiparasitic species but not host specific. Originally the Furbish lousewort was hypothesized to possibly be associated with downy alder (Alnus viridis subsp. crispa) which is prevalent along the banks of the St. John. One of the three populations in New Brunswick, however, has no alder in the vicinity of a vigorous lousewort colony.

Field studies were undertaken in 1977 by Dr. Lazarus Macior to assess the existence of a parasitic association between the lousewort and other plant species. No such association was observed with mature lousewort roots after careful investigations. Subsequent efforts to propagate lousewort from seed have determined that haustoria, i.e. parasitic root connections, definitely are formed at least during seedling development. Louseworts grown with crimson clover (Trifolium incarnatum) and wheat (Triticum aestivum), neither of which occur in the lousewort's natural environment, show haustoria firmly established. Lousewort seedlings grown without a host became chlorotic and most had died after 20 weeks. Lousewort seedlings grown with clover and wheat grew vigorously until the host died. Additional investigations have determined that perhaps a wide spectrum of hosts is possible and that substrate, pH and other factors may influence haustoria formation.

Threats to the Species' Existence

The fate of the Furbish lousewort is inextricably tied to the fate of the St. John River and its unique riverbank ecosystem. The physical, chemical and hydrological characteristics of the St. John River have created a diverse assemblage of rare flora with which the Furbish lousewort is associated. This diversity is exemplified by the fact

that two other plants known to occur on the banks of the St. John are being considered for listing under the Endangered Species Act of 1973. These plants are the field oxytrope (Oxytropis campestris var. johannensis) and the New England violet (Viola novae-angliae). In addition, 31 species identified in "Rare and Endangered Vascular Plant Species in Maine," L. M. Eastman, 1978, are known to occur on the St. John River.

At the time the U. S. Fish and Wildlife Service officially listed the Furbish lousewort as an endangered plant (U.S. Fish and Wildlife Service, 1978) the most notable threat to the species' continued existence was the proposed Dickey-Lincoln School Lakes Hydroelectric Project. The proposed project, if implemented as planned, would have inundated 66 miles of the St. John River - a major portion of the species essential habitat. Based on the 1980 field surveys, 19 of 28 known colonies representing 71 percent of the total known population were within the proposed impoundments. The remaining nine lousewort colonies were all downstream from the project. The alteration of the river's annual flow regime would also impact these remaining colonies, including three in Canada. Although Congress deauthorized the Dickey Dam portion of the project in December of 1981, investigations are continuing on the feasibility of a smaller project at Lincoln School only. Approximately 60 percent of the known lousewort population occurs in the area that could be affected by the Lincoln School project.

In addition to the continuing threat of hydropower development, the riverbanks on the lower St. John have been and continue to be altered

by a number of activities which adversely effect the Furbish lousewort. Agricultural utilization of the St. John Valley gradually intensifies from Allagash downstream to the U.S./Canadian border in Hamlin, Maine. In many instances the hardwoods, pine, spruce and fir trees have been cleared to the river's edge and these segments of riverbank no longer provide the degree of shade conducive to lousewort growth and reproduction. It is not known if louseworts did originally occur along these stretches but the habitat has certainly been altered and no louseworts have been found. Other development pressures exist including the building of homes and camps on the river's edge, subsequent clearing of trees, dumping of litter and recreational utilization. One historical lousewort site is now occupied by a swimming-picnicking area.

Two of the three lousewort stations in Canada are also threatened by the possible modification of the existing dam at Grand Falls and the creation of an additional hydropower facility near Morrill, New Brunswick.

Conservation Measures

Efforts to protect the Furbish lousewort were initiated immediately following Dr. Richards' discovery in 1976. Representatives from the U. S. Fish and Wildlife Service, the New England Division of the Corps of Engineers and scientists from the United States and Canada, met on March 9, 1977, to formulate protection strategies and priorities for additional studies. Several specific recommendations were made. Research on species biology and expanded field surveys were begun in the summer of 1977 in both the U.S. and Canada. The information developed as a result of these investigations provided solid scientific support to

officially list the Furbish lousewort as an endangered species on April 26, 1978.

In compliance with Section 7 of the Endangered Species Act, the Corps requested formal consultation with the Service on May 5, 1978, regarding the proposed Dickey-Lincoln Project's impact on the Furbish lousewort. The Service issued a biological opinion to the Corps on June 27, 1978, stating:

"the Dickey-Lincoln School Lakes project, as presently planned, is likely to jeopardize the continued existence of the Furbish lousewort unless the conservation program recommended in this opinion is initiated and successfully carried out by the Corps in consultation with and with the assistance of the Service."

Specific items included in the conservation program were:

1. Development of information which will lead to a functional understanding of the habitat needs and propagation techniques of the Furbish lousewort.
2. Acquisition and protection of existing habitats below the project impoundments area currently supporting lousewort populations.
3. Acquisition of habitat identified as capable of supporting new populations of louseworts.
4. Establishment of new self-sustaining colonies through transplantation, seeding or other appropriate techniques.

5. Obtaining better information on what the effects will be of downstream flows, after construction of the project, on the lousewort and its habitat.
6. Development of a monitoring program which will be capable of detecting any changes in lousewort biological status, such as habitat changes, population increases or decreases, and microclimatic conditions.

If the Corps is directed by Congress to further study the Lincoln School Project, formal consultation with the Corps would again be required and elements of the above six-point conservation program might still be appropriate.

Other agencies and organizations are making significant efforts to conserve and protect the Furbish lousewort. The Nature Conservancy is actively pursuing the formal protection of several areas which are considered to be most representative of the floristic diversity that typify the St. John. Some of these areas support vigorous lousewort colonies.

Increased riverbank development in 1978 - 1982 which adversely impacted some colonies prompted the Service to initiate a project in June of 1981 with the Maine State Planning Office's Critical Areas Program. The major objectives of the project were to alert individuals to the existence of louseworts on their land and encourage their voluntary cooperation in site protection. The Critical Areas Program has been very effective in protecting other unique natural features in the state of Maine by increasing public awareness and encouraging private conservation. Initial responses to the present effort in the St. John Valley are most encouraging.

On September 15, 1982, Maine's Land Use Regulation Commission approved a comprehensive protection plan for approximately 100 miles of the St. John River upstream from Allagash. The plan prohibits or restricts development and establishes recreational and timber harvesting policies in a 250 foot corridor on either side of the river.

Canadian officials also recognize the significance of and the need to protect the Furbish lousewort. The Committee on the Status of Endangered Wildlife in Canada has formally declared the species to be endangered in Canada. On November 12, 1980, Provincial authorities also declared the lousewort to be an endangered species in New Brunswick, the first plant so designated. Efforts are presently underway to designate one of the three Canadian lousewort colonies as an "ecological preserve."

Part II

Recovery

Primary Objective: To protect and maintain a reproducing population of the Furbish lousewort on the St. John River in northern Maine. This can best be accomplished by protecting the St. John River riparian ecosystem, maintaining the continued existence of all 28 presently known lousewort colonies and establishing ten new reproducing colonies on the upper St. John River. Accomplishment of this three-part primary objective would insure the continued existence of the species and enable the Service to consider downlisting to threatened status. Specific measures that lead to accomplishment of the primary objective are identified in the following step-down outline and narrative.

Step Down Outline

1. Protect the riparian ecosystem of the St. John River.
 - 1.1 Extend the existing congressional moratorium on hydro-electric projects.
 - 1.2 Implement the 1982 St. John River Resource Protection Plan.
 - 1.3 Review community zoning standards for shoreland protection.
 - 1.4 Insure all federal agencies comply with congressional directives of the Endangered Species Act.
2. Protect all existing lousewort colonies.
 - 2.1 Determine ownership of all extant colonies.

- 2.2 Designate state critical areas and encourage landowner conservation.
- 2.3 Secure formal protection agreements for the most significant lousewort colonies.
- 2.4 Conduct general information and education efforts in the St. John Valley.
3. Monitor species' distribution and population trends.
 - 3.1 Conduct periodic surveys and develop population estimates.
 - 3.2 Conduct quantitative analyses at six specific colonies.
4. Conduct studies on species biology.
 - 4.1 Research nutritional requirements.
 - 4.2 Assess severity of insect infestations.
 - 4.3 Determine lousewort colonies' riverbank elevation relative to various flow conditions.
 - 4.4 Assess annual flow regime's significance to species distribution, abundance, dispersal and habitat requirements.
5. Conduct habitat surveys.
6. Establish additional lousewort colonies on the upper St. John.
7. Develop management recommendations for each lousewort colony.
8. Coordinate activities with local, regional, state and federal agencies.
 - 8.1 Contact local and regional planning organizations.
 - 8.2 Establish and maintain international cooperation.

Step Down Outline Narrative

1. Protect the riparian ecosystem of the St. John River.

1.1 Extend the existing congressional moratorium on hydro-electric projects.

The Dickey Dam portion of the Dickey-Lincoln School Lakes Hydroelectric Project and its associated transmission facilities were deauthorized by Congress on December 29, 1981 as part of Public Law 97-108. In addition to the deauthorization of Dickey Dam, Congress also declared that "no federal agency or department shall consider any license application relating to hydropower projects above the site of the Lincoln School Dam on the Saint John River and its tributaries, Maine, for a period of two years after the enactment of this Act." The provisions of this declaration should be enforced and extended beyond December 29, 1983 to insure continuing protection of the St. John River ecosystem.

1.2 Implement the 1982 St. John River Resource Protection Plan.

On September 15, 1982, the Maine Land Use Regulation Commission (LURC), the state agency responsible for land use controls in the unorganized portions of the state, approved a resource protection plan initiated by the St. John landowners. Lands covered by the plan are within a corridor on either side of the St. John from 400 feet downriver of the Baker Branch Bridge in T7 R17 WELS to the foot of Big Rapids in the town of Allagash. The plan prohibits commercial and residential development,

subdivisions, water impoundments and utility facilities; regulates timber harvesting and restricts construction of roads, bridges and gravel pits; and provides for recreational management according to described policies and standards.

Nine lousewort habitat locations are identified and mapped in the resource protection plan as sensitive areas. Timber harvesting within 200 feet of these areas "may be conducted only after consultation with LURC, and shall proceed only after adequate protection is afforded." Effective implementation, including judicious enforcement, of the provisions of this plan, therefore, will provide an important and necessary measure of protection to known lousewort colonies above Big Rapids.

1.3 Review community zoning standards for shoreland protection.

Existing community shoreland zoning ordinances and plans need to be reviewed as to their adequacy for protecting lousewort habitat. Enforcement procedures should be particularly emphasized. The Main State Planning Office should work with the towns along the river outside of LURC jurisdiction to accomplish this review. Specific recommendations for improvement would be made as necessary.

1.4 Insure all Federal agencies comply with congressional directives of the Endangered Species Act.

Section 7 of the Endangered Species Act requires Federal agencies to consult with the Fish and Wildlife Service to insure any action they authorize, fund or carry out

is not likely to jeopardize the continued existence of any endangered or threatened species. The US Army Corps of Engineers, Federal Energy Regulatory Commission or any other Federal agency authorized by Congress to undertake specific projects in the St. John Valley or responsible for issuing or authorizing permits to carry out private actions must comply with the provisions of Section 7.

2. Protect all existing lousewort colonies.

2.1 Determine ownership of all extant colonies.

The Service and the Maine Critical Areas Program initiated a program in 1981 to determine landowners of the most significant lousewort sites. Efforts thus far have been concentrated in the towns of Allagash and St. Francis. This effort must be continued and expanded to include all extant lousewort colonies in the St. John Valley and any colonies that are discovered in future surveys.

2.2 Designate state critical areas and encourage landowner conservation.

As part of the 1981 cooperative effort between the Fish and Wildlife Service and the Critical Areas Program, several landowners with louseworts on their property were personally contacted. Landowners were apprised of the significance of the plants on their land and encouraged to voluntarily protect and conserve the site. This effort should be continued and expanded to include all landowners in the St. John Valley with louseworts on their property.

Amicable landowner relationships should be nurtured and maintained by annual visits. The formal registration of these sites as State Critical Areas would effectively accomplish this objective.

2.3 Secure formal protection agreements for the most significant lousewort colonies.

The most vigorous lousewort colonies presently occur in the towns of Allagash and St. Francis. The Nature Conservancy, a national nonprofit conservation organization, is presently pursuing the formal protection of several of these key sites as directed by the Maine Chapter Board of Trustees. Securing representative lousewort colonies in the organized towns is most important in light of increasing riverbank development and modification. Formal protection of the three highest priority sites should be expedited.

2.4 Conduct general information and education efforts in the St. John Valley.

The future character of the St. John Valley, particularly from Allagash downstream to Hamlin, will largely reflect the attitudes and concern of the people that live there. General informational brochures, displays, posters, etc., should be placed in local schools and town halls to increase the general public's awareness of endangered species and the importance of protecting the St. John ecosystem.

3. Monitor species' distribution and population trends.

3.1 Conduct periodic surveys and develop population estimates.

Factors such as accessibility, the total number of river miles (140) along which louseworts are known to occur and the difficulty of finding seedlings in dense herbaceous vegetation all influence the accuracy of total population estimates. Field surveys every three years can, however, provide a general quantitative assessment and should be continued to monitor population trends.

3.2 Conduct quantitative analyses at six specific colonies.

In combination with the general survey recommended above, detailed quantitative studies via quadrat analysis should be conducted on at least six lousewort colonies. Quadrats should be two meters square and permanently marked. All herbaceous plants should be plotted and spacial relationships between mature lousewort plants and seedlings accurately determined. The plants' growth and development will be periodically monitored throughout the field season.

4. Conduct studies on species biology.

4.1 Research nutritional requirements.

Although no root haustorial connections were observed in mature plants during the 1977 field studies, more recent investigations have determined that Pedicularis furbishiae is a root hemiparasite in the seedling stages of development. The role of root haustoria in plant development, factors contributing to the formation of haustoria and their relationship to lousewort nutritional requirements need to be determined.

4.2 Assess severity of insect infestations.

Several lousewort colonies are severely infested by spittle bugs and in some instances an estimated 90 percent of immature inflorescences are damaged by spittle bug activity. Many inflorescences subsequently do not reach their maximum seed production capability. A professional entomologist should assess the character and degree of infestation and advise on appropriate management actions.

4.3 Determine lousewort colonies' riverbank elevation relative to various flow conditions.

The riverbank elevation span for known lousewort colonies will be determined and compared with the U.S. Geological Survey monthly discharge data base for the years 1946-1981. Composite river bank profiles for each lousewort colony will then be developed. Each colony's elevation will be correlated to maximum, minimum and average monthly flow regimes.

4.4 Assess annual flow regime's significance to species distribution, abundance, dispersal, and habitat requirements.

The flow regime profiles developed in task 4.3 will be used to assess the role that those flows may have on the life processes and apparent habitat requirements of the

Furbish lousewort. All available species biology information that is now known or becomes known as part of this recovery plan will be evaluated.

5. Conduct habitat surveys.

Suitable habitat areas need to be selected in attempts to establish ten additional self-sustaining colonies within the protected area on the upper St. John. Qualitative judgements of suitable areas will be made considering aspect of slope, shade, soil types and plant associations.

6. Establish additional lousewort colonies on the upper St. John.

Using seed from mature plants, attempts will be made to establish ten self-sustaining, reproducing colonies on the banks of the upper St. John. Preparation of seed beds will be undertaken to facilitate seedling establishment. Each site will be permanently marked and periodically monitored.

Establishment of ten additional colonies on the upper St. John is based on historical evidence indicating approximately 70 collections of the Furbish lousewort were made by various botanists since the late 1800's. Although specific locations are generally not discernible from these early collections, certainly some sites were collected more than once while other sites were perhaps never collected. How many colonies did actually exist is subject to speculation. Those present day colonies occurring downstream of Big Rapids in the town of Allagash will, however, by virtue of their proximity to urbanization, probably always remain somewhat vulnerable.

The successful establishment of ten additional self-sustaining, reproducing colonies within the area administered by the 1982 Resource Protection Plan on the upper St. John will insure that an equal number of colonies now known to occur throughout the St. John Valley will exist within a protected area.

7. Develop management recommendations for each lousewort colony.

Specific recommendations to protect or enhance each lousewort colony will be made on a case-by-case basis. Previous research and information developed as part of this plan should provide a sound basis for these recommendations. Appropriate management actions will be discussed with individual landowners. Specific management actions will only be taken contingent upon landowner approval.

8. Coordinate activities with local, regional, state and Federal agencies.

The conservation and recovery of the Furbish lousewort and the protection of its habitat are responsibilities shared by many individuals and organizations. The effective implementation of this recovery plan will necessitate a great deal of coordination between a multitude of agencies, organizations and individuals.

8.1 Contact local and regional planning organizations.

Local planning boards, conservation commissions and regional planning commissions need to be aware of protection efforts. Local zoning can play a

significant role in protecting lousewort habitat.

Where specific plans exist they need to be evaluated for their compatibility with the conservation and protection of the Furbish lousewort. Where community development plans do not exist they should be developed with full consideration to protecting the St. John riverbanks. The cooperation and assistance of the Northern Maine Regional Planning Commission are especially needed. A briefing will be arranged with the Commission and appropriate staff regarding this recovery plan and the conservation and protection program.

8.2 Establish and maintain international cooperation.

Protection efforts in the United States need to be coordinated with possible conservation measures in Canada. The International Joint Commission can play a key role in this coordination. Of particular concern is the possible modification of the hydropower facilities at Grand Falls, New Brunswick. A vigorous lousewort colony exists at the international border possibly occurring in both countries. Any modification and/or change in the power pool at Grand Falls could have a significant impact on this colony.

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PHASE: AGENCY DRAFT

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY OR ORGANIZATION	FISCAL YEAR COSTS (EST)					COMMENTS/NOTES
						FY 1	FY 2	FY 3	FY 4	FY 5	
03	Extend Existing Moratorium	1.1	1	Ongoing		-	-	-	-	-	Congressional action
02	Implement Resource Protection Plan	1.2	1	10 yrs.	Maine Land Use Regulation Commission	-	-	-	-	-	Ongoing legal responsibility
01	Review Community Zoning	1.3	2	1 yr.	Maine State Planning Office	500	500	500	500	500	
01	Agency Compliance E.S.A.	1.4	1	Ongoing	US FWS	-	-	-	-	-	
A7	Determine Ownership	2.1	1	1 yr	Maine State Planning Office	2700	2700	-	-	-	Initiated in 1981
M7	Designate State Critical Areas	2.2	1	2 yrs.	" "	2500	2500	-	-	-	
A6	Secure Protection Agreements	2.3	1	Ongoing	The Nature Conservancy	1500	1500	1500	1500	1500	Initiated in 1981
01	Information/ Education	2.4	3	3 yrs.	Maine State Planning Office	1500	1500	1500	-	-	
11	Population Surveys	3.1	2	Ongoing	US FWS/State Planning Office	1500	-	1500	-	1500	Initiated in 1981

PHASE: AGENCY DRAFT

IMPLEMENTATION SCHEDULE (Cont'd.)

GENERAL CATEGORY	PLAN TASK	TASK #	PRIORITY #	TASK DURATION	RESPONSIBLE AGENCY OR ORGANIZATION	FISCAL YEAR COSTS (EST)					COMMENTS/NOTES
						FY 1	FY 2	FY 3	FY 4	FY 5	
11	Quantitative Analyses	3.2	2	5 yrs.	US FWS	500	500	500	500	500	
R3	Research Nutritional Requirements	4.1	3	3 yrs.	US FWS	5000	5000	5000	-	-	
R11	Assess Insect Infestation	4.2	3	1 yr.	US FWS	1500	-	-	-	-	
12	Determine Colony Elevations	4.3	2	1 yr.	US FWS	2500	-	-	-	-	
R3	Assess Flow Significance	4.4	2	2 yrs.	US FWS	1000	1000	-	-	-	
12 A	Habitat Surveys	5	2	1-2 yrs.	US FWS/State Planning Office	500	500	-	-	-	
13	Establish Additional Colonies	6	3	5 yrs.	US FWS	1500	1500	1500	1500	1500	
M3	Management Recommendations	7	2	1-2 yrs.	Maine State Planning Office	500	500	-	-	-	
01	Contact Planning Organizations	8.1	2	1 yr.	US FWS/State Planning Office	500	-	-	-	-	
01	International Cooperation	8.2	2	Ongoing	US FWS	-	-	-	-	-	

REVIEWING AGENCIES

Maine Chapter
The Nature Conservancy
20 Federal Street
Brunswick, Maine 04011

State of Maine
Department of Conservation
State House Station 22
Augusta, Maine 04333

State of Maine
Executive Department
State Planning Office
184 State Street
State House Station 38
Augusta, Maine 04333